THE SCIENCE OF SOCIAL ADJUSTMENT

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THE SCIENCE
OF
SOCIAL ADJUSTMENT

BY

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PREFACE

I HAVE recently made several studies in the relations between Science and Society, in discourses and addresses to the British Association for the Advancement of Science, to the British Science Guild, and the Eugenics Society, and these, with much rearrangement, omission, and new matter (including the whole of Chapter IV), are now published under this general title, *The Science of Social Adjustment*, as a small contribution to a new emphasis or area of scientific study which the times so urgently demand if we are to stave off Emerson's verdict: "The end of the human race will be that it will eventually die of civilisation".

There is a growing literature upon the direction of economic society written, if not expressly, certainly in effect, from the point of view of totalitarian control. If we make the assumption, usual to the writers, that such a scheme can retain all the present benefits and potentialities of the existing scheme, and can add all its own virtues, it is not really a very difficult intellectual exercise to create the utopias of universal technological plenty, scientific bounty, and every other boon—except liberty. But I do not think it is really profitable, for I doubt whether this country

wishes to go that way. It is a more difficult task to point to the next practical steps in the evolution of regulated individualism, which endeavours to preserve as much of the cardinal spirit of our present order, with social direction and limitation in the common good. But some preliminary steps in a study for this science of social adjustment are attempted in a fragmentary way in this volume.

J. C. S.

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CHAPTER I

THE IMPACT OF SCIENCE UPON SOCIETY *

Wherever and whenever new science touches society it creates a disturbance which has hitherto been mostly accepted as inevitable, but is often a high price for progress. The study and control of this impact constitutes the science of social adjustment.

THE reactions of society to science have haunted the minds of scientists themselves, as well as philosophers, statesmen, and preachers, with various misgivings for some years past. In his great centenary address to the British Association for the Advancement of Science, General Smuts, answering the question " What sort of a world picture is science leading to ? ", declared that one of the great tasks before the human race is to link up science with ethical values and thus remove grave dangers threatening our future. For rapid scientific advance confronts a stationary ethical development, and science itself must find its most difficult task in closing a gap which threatens disruption of our civilization, and must become the most effective drive towards ethical values. In the following year a great engineer spoke as a disillusioned man, who watched the sweep-

* Presidential Address delivered to the British Association for the Advancement of Science at Blackpool, 1936, with modifications and additions, especially from the *Hibbert Journal*, 1934.

ing pageant of discovery and invention in which he used to take unbounded delight, and concluded by deploring the risk of losing that inestimable blessing, the necessity of toil and the joy of craftsmanship, declaring that spiritual betterment was necessary to balance the world. Then came the president of the Royal Society, a supreme biochemist, on the perils of a leisure made by science for a world unready for it, and the necessity for planning future adjustment in social reconstructions. Followed the astronomer, deploring man's lack of moral self-control ; in knowledge man stands on the shoulders of his predecessor, whereas in moral nature they are on the same ground. The wreck of civilization is to be avoided by more and not by less science. Lastly, the geologist gloried in the greatest marvel of millions of centuries of development, the brain of man, with a cost in time and energy that shows us to be far from the end of a mighty purpose, and looked forward confidently to that further advance which alone can justify the design and skill lavished on such a task. So the geologist pleads now for scientific attention to man's mind. He has the same faith in the permanence of man's mind through the infinite range of years

> That oft hath swept the toiling race of men
> And all their laboured monuments away,

that is shown at the Grand Canyon, where, at the point exposing, in one single view, over a billion and a half years of the world's geological history, a tablet is put to the memory of Stephen Tyng Mather, the founder of the National Park Service, bearing what is surely the most astonishing scientific expression of faith ever so inscribed : " There will *never come an end* to the good that he has done ".

The leaders of scientific thought have thus been pleading in turn for ethical values, for spiritual betterment, for right leisure, for moral advance, and for mental development, to co-ordinate change in man himself with every degree of advance in natural science in such a harmony that we may at last call it 'progress'. This extension of their deeper concern beyond their main concern is not really new, but it has taken a new direction. I find that exactly one hundred years ago there was a full discussion in the British Association on the moral aspects—a protest that physical science was not indeed, as many alleged, taking up so much of the attention of the public as to arrest its study of the mind, of literature, and the arts; and a round declaration that by rescuing scientists from the narrowness of mind which is the consequence of limiting themselves to the details of a single science, the Association was rendering "the prevailing taste of the time more subservient to mental culture". A study of these early addresses shows that we are more diffident to-day in displaying the emotions and ideals by which I do not doubt we are all still really moved. But they also show that we are preoccupied to-day with some of the results of scientific discovery of which they were certainly then only dimly conscious. We are concerned not merely with the old problem how far economic progress is identical or consistent with progress in the noblest or largest sense, but also how far scientific discovery is contributing to economic progress in the best way. We are concerned with the way in which discovery actually impinges upon economic life, or with its *impact* upon society.

Impact as the Point of Continuous Change

What do we mean by impact? The term is not intended to cover the whole influence or effect of science upon society—that would be too vast, varied, and indeterminate for a single volume. We may consider the position of the average man, along a line of change we call 'progress', at the beginning of a certain interval of time and at its end. We might then analyse how much is due to a change in the average man himself, his innate physical and mental powers, and how much to other influences, and particularly to science. We may debate whether the distance covered is great or small by some assumed standard, and whether progress has been rapid. We might ask whether the direction has been right, whether he is happier or better—judged again by some accepted standard. But our immediate concern is with none of these questions. I ask whether the transition has been difficult and distressing, in painful jerks and uprootings, costly, unwilling, or unjust; or whether it has been easy, natural, and undisturbing. Does society make heavy weather of these changes, or does it, as the policeman would say, 'come quietly'?

The attitude of mind of our order may be either that change is an interruption of rest and stability, or that rest and stability are a mere pause in a constant process of change. But these alternatives make all the difference to its accommodating mechanisms. In one case there will be well-developed tentacles, grappling irons, anchorages, and all the apparatus of security. In the other, society will put on castors and roller bearings, cushions, and all the aids to painless transition. The *impact* of science will be surprising

and painful in the one case, and smooth and undamaging in the other. Whatever may be the verdict of the past, is society and its institutions now learning that change is to be a continuous function, and that meeting it requires the development of a technique of its own ?

Scientific discovery itself, prior to its applications, has no moral, ethical, or even economic quality. We slip easily into the assumption that every new revelation of the facts of nature will be a ' contribution ' to progress. But of course, on reflection, we realize that we then take it for granted we shall *select* just those discoveries which, on application, will contribute to economic progress, and leave the rest dormant. We also assume that we shall apply them in the right way and at the right time, being too wise to spoil a good thing by bad manners and methods. These are large unverified assumptions, and to begin with the true nature of economic progress itself is not so widely appreciated that we can feel much confidence about them.

What is Economic Progress ?

Economic progress is the orderly assimilation of *innovation* into the general standard of life. I use the word ' innovation ' advisedly, for ' invention ' has too mechanical a connotation, and we must include processes and the consequences of discovery. Vitamins are not an invention, but their discovery is innovation in knowledge. Canning has not been invented recently, but its extension to vegetables, fruit, and poultry in our home counties is an innovation which disturbs many factors before it is finally assimilated.

So economic progress usually connotes a widespread sharing of new benefits, but is by no means inconsistent with some degree of uneven distribution of wealth or income. In a non-socialistic community, in my judgment, some disparity generally raises the standard of life of the mass to a point higher than it would be under a forced equality of distribution of wealth, the envies and illusions caused by disparity notwithstanding. The purely material standard in Great Britain was raised fourfold during the nineteenth century,[1] and probably rather more in the United States. If we take into account also length of life and the proportion of leisure, the increase is much greater. Here I draw attention particularly to the limitation of this expression—the standard of life—its quantitative nature. It may tell us that the average man can afford four times as many candles as his forerunner a hundred years ago, but it says nothing of the qualitative evolution of his expenditure through oil, gas, gas incandescence, up to electric light. It says nothing of the amenities of a bicycle, or the significance of insulin.

This fourfold improvement arises only to a very small extent through changes in the average innate capacity of man not co-operant with, or parasitic upon, his environment. It is almost all due to innovation in social activity (including social education and the reactions of economic betterment upon physical and mental ability). The greater part of the innovation is scientific innovation, in physics, engineering, and public health, but a not inconsiderable part falls outside these categories, and belongs to the non-physical section—better ideas about money, more social confidence in banking and credit, improved political and

[1] Vide my *Wealth and Taxable Capacity*.

social security, and legal frameworks for the better production and diffusion of wealth. The elaboration of these factors depends partly on intellectual prevision and invention, but mainly upon average moral standards and calibre of character, since many political schemes, including international co-operation, are impracticable just because and only because of failings or fallings short in the present standards of human nature. It is being commonly stated that scientific changes are coming so thick and fast, or are so radical in their nature and implications, that the other factors of social life, the intangibles of credit, the improvements in political and international organizations and ideas, are unequal to the task of absorbing and accommodating them, or else that the changes present new problems which have no counterpart on the social side. For example, the power and practice of broadcasting internationally, from Moscow in propaganda, or between America and England for purposes of mutual enlightenment on points of view, or round the Empire for a binding sentiment, may—perhaps must—have great ultimate consequences, socially and politically; but the problems it creates have no precedent or guides from the past, and may liquefy set conditions or harden fluid ones before we are ready for the consequences. If changes in social forms and human nature or behaviour cannot possibly be made rapidly enough for the task, then in that sense science may 'ruin' economic progress, and it is at least conceivable that the actual economic world might be better served in the end if scientific innovation, as distinct from research, were retarded to the maximum rate of social and economic change or accommodation.

We shall have much to say upon this question of

pace of application, or perhaps it would be better to call it a question of appropriate *time* of application. For it would be a strange coincidence if the fortuitous moment of scientific discovery should also happen to be the precise moment when society was most fitted to be injected with it, to receive it, and absorb it. But a glance may first be given to the prior question whether economic progress is advanced in any circumstances or at any time by certain discoveries.

First, for example, the utilization of rare minerals for essential or competitive purposes, as we have learnt from Sir Thomas Holland's addresses and writings, where the full social or political consequences of the new uses found for certain minerals has begun to dawn on some of us. This utilization of natural products, the need for which becomes general, but the distribution of which is particular and accidental, sets up great political strains, and we have invented no means of adjusting the international effects of accidental monopoly of essential elements. They may even be regarded as " causes of war " as well as means for its prevention.[1] Second, the problem of scope, where the scale of production upon which, for example, a chemical innovation can be made to give its real economic advantages, may be a scale inconsistent with the size of markets freely open in a nationalistic world. Here strains are set up in the international machine and the balance of trade, which may gravely jeopardize economic progress, and dry up the juices of commerce. One may think of powerful industrial nations setting up synthetic nitrogen plants on a scale each scientifically correct in a productive sense, but not

[1] Vide my Chapter in *The Causes of War*.

as a whole adapted to a real world of isolated nationalistic consumption.

In the third case, where the innovation is absorbed most easily for offensive purposes in a military or naval sense, it may create rivalries and changes of balance of power inimical to economic security, and compel new economic sacrifices outweighing the direct economic advantages of peaceful uses. It is open to question whether the innovation of aircraft has yet become, on net balance, economic progress. What it has added to the standard of life in a civil direction may still be outbalanced by the new burdens in other directions for offence and defence, and by some loss of amenity.

The Impact upon Industry and Society

Enough has been said to show that discovery and progress may not be synonymous. But we shall pass away from any question as to wisdom of application to assume that discovery ought in general to be applied to life, at some point of place and time most appropriate. The impact upon industry itself is a limited part of the larger field of the impact upon society, and it is convenient to give some consideration to the larger aspect first.

Science itself has usually no immediate impact upon institutions, constitutions, and philosophies of government and social relations. But its *effects* on people's numbers, location, and habits soon have; and the resistance and repugnance shown by these institutions and constitutions to the changed needs may rebound or react through those effects upon scientific enterprise itself, and make it more precarious or more

difficult. Thus the effect of applications of electricity and transport improvements is clearly to make the original areal extent of city or provincial Governments quite inappropriate, and the division of functions and methods of administration archaic.[1] If these resist change unduly, they make it more difficult and frictional, and the applications of science less profitable and less readily acceptable. "Time makes ancient good uncouth." When two bodies are violent or ungainly in impact, both may be damaged. If the written constitution of the United States, devised for the 'horse and buggy' days, still proves not to be amenable to adjustment for such demands, it will be difficult to overstate the repercussion upon economic developments and the scientific enterprise that originates them. Let any Supreme Court decision of unconstitutionality on the Tennessee Valley experiment in large-scale science applied to natural problems on a co-ordinated plan bear witness. Such unnecessary resistance may be responsible for much of what has been aptly called 'the frustration of science'.[2]

Avoidable friction in the reception given to scientific discovery not only deprives the community of advantages it might otherwise have enjoyed much earlier, or creates a heavy balance of cost on their adoption; it may also discourage applied science itself, making it a less attractive and worth-while

[1] "In the United States Counties were originally organized to meet pioneer conditions of distance and slow transportation." The movement for consolidation has been considered in ten and adopted in five States. Some remarkable economies have resulted. "Sunflower County spends only one-fourth as much as the combined expenditure of four smaller Counties whose total area equals that of Sunflower."—W. and K. Cordell, "Taxpayer, meet your County" (*Survey Graphic*).

[2] Vide the volume *The Frustration of Science*, by various authors, 1935.

pursuit. In that sense we are considering also the impact of society upon science. This, too, is not new. The British Association had as one of its first objects " to obtain a more general attention to the objects of Science, and a removal of any disadvantages of a public kind which impede its progress ". The first address ever offered affirmed that the most effectual method of promoting science was the removal of the obstacles opposing its progress, and the president instanced the very serious obstacles in the science of optics due to the regulations relating to the manufacture of glass. To-day, perhaps the scientist places more stress upon the failure of Governments to encourage than upon their tendency to discourage.[1] So much then for the *idea* of impact. Is the scientist or inventor responsible for impact, and if not, who is ?

The Question of Responsibility

Elsewhere I have retouched Jeremy Bentham's poignant picture of the inventor of over a century ago, plans and cap in hand, on the doorstep of the rich or influential, waiting for someone to believe in him. From this type of external ' sport ' amongst engineers and scientists came much or most industrial innovation, external to the processes of business. To-day, in the older and applied sciences affecting industry, the solo scientist is the exception, and, with the large

[1] But the discouragement is by no means obsolete. " An essential part of the reaction of Capitalism to this crisis is the restriction of output and the curtailment of the introduction of new machinery. The result is a lower standard of life for the workers. I see from the newspapers that laws against the introduction of new machinery in certain industries and against the further rationalisation of trade are already in force in Germany, Italy, and U.S.A." (Prof. P. M. S. Blackett in *The Frustration of Science*, p. 135).

research departments of particular businesses and trade research associations, the picture is quite different—the expenditure higher, but the results much more rapid and numerous, even if for a time they may be kept secret. Although records of finished work may be available over the civilized world, there is much overlapping of current work, but the price of this as a whole is a far smaller fraction of the total result, if we omit from our consideration the first-magnitude discoveries of epoch-making influence. The industrial community is now far more amenable than hitherto to scientific influence ; indeed it is often the instigator in the mass of minor advances.

The new epoch of concerted industrial research dates really from the end of the Great War. During all that time I have held some middle position of responsibility between the research laboratories and institutes on the one hand, and the costing and profit and loss accounts on the other, and my impression is that the proportion of work in which the initiation comes from the business end is steadily increasing. In studies of the periods of scientific and industrial gestation respectively, I have elsewhere defined *scientific gestation*[1] as the time elapsing between the first concept of the idea and its public presentation to society in a form substantially that in which it ultimately finds extensive use without important modification ; and *industrial gestation* as the period elapsing from this point to the date when in an economic or industrial sense the innovation is effective. Both periods are difficult to determine exactly in practice, but on a broad view, the period of industrial gestation, with which alone I am here concerned, appears to me cer-

[1] In "Invention" (Watt Lecture) in *Economic Factors in Modern Life.*

tainly to have shortened materially, though possibly at greater social cost. It would obviously be so if industry is actively encouraging research. "Faraday's discoveries came at the beginning of the great steam era, and for fifty years there would have been no difference in transport, even if those discoveries had not been made", for the telegraph was the only material influence upon it, and practical lighting was delayed until 1900.[1]

In nearly every scientific field there is subdivision of labour, and it is rare that the worker who digs out new truth 'at the face', so to speak, is also responsible for bringing it to the surface for the public use, still less for distributing the new scientific apparatus or ideas broadly, and even less for the profitable exploitation of the whole process. These functions are nearly always distinct, even though they are embraced under the one general popular description: chemist, engineer, etc. But in few cases is it any part of the professional training in the subject itself to study how new products or processes affect the structure or welfare of society. I have questioned many scientific workers and find them, of course, keenly alive to the positive and direct beneficial effects of their work, but they have rarely any quantitative ideas as to negative, indirect, and disturbing consequences.

All these discoveries, these scientific infants, duly born and left on the doorstep of society, get taken in and variously cared for, but on no known principle, and with no directions from the progenitors. Nor do the economists usually acknowledge any duty to study

[1] Vide my estimate, under the title "Electricity in Transport" given at the Faraday Centenary Celebrations (*Journal of the Institution of Electrical Engineers*, November 1931).

this phase, to indicate any series of tests of their value to society, or even of methods and regulation of the optimum rate of introduction of novelty. These things just 'happen' generally under the urge of profit, and of consumers' desire, in free competition, regardless of the worthiness of new desires against old, or of the shifts of production and, therefore, employment, with their social consequences. The economist rightly studies these when they happen, but he is not dogmatic about them not being allowed to happen at all in just that way on account of the social disturbance or degradation of non-economic values which they may involve. It is truly a 'no-man's-land', for it is rarely that the functions of government begin until a vested problem exists. Especially in Britain we do not anticipate—"Don't worry; it may never happen". Problems with us are usually called 'academic' until we are 'going down for the third time'. It is a maxim of political expediency not to look too far ahead, for it is declared that one will always provide for the wrong contingency. The national foresight over wireless was exceptional, and it has to be contrasted with the opportunist treatment of the internal combustion engine. In reply, it can, of course, be urged that no one can foresee just how a scientific idea will develop until it is tried out, rough and tumble, in economic society, and to make anticipatory rules may even hinder its development. Mr. Gladstone is said to have declared that he had never been "able sufficiently to adjust the proper conditions of handling any difficult question, until the question itself was at the door".

The Scientific Worker in the Wider Field

It is rightly stated that the training of the scientist includes no awareness of the social consequences of his work, and the training of the statesman and administrator no preparation for the potentiality of rapid scientific advance and drastic adjustment due to it, "no prevision of the technical forces which are shaping the society in which he lives".[1] The crucial impact is nobody's business.

When the research worker lifts his attention from his immediate pursuit and contemplates its hinterland, he has three possible areas of thought. He may dwell upon its practical applications and seek to make them as immediate and realistic as possible; moved by the desire not to be merely academic, he may return to his task, to focus his attention primarily on what is likely to be of practical utility, rather than on what is intellectually intriguing. Or he may think of its ultimate social consequences, and speculate on the shifts in demand, the unemployment, the loss of capital, the ultimate raising of the standard of life that may result—in other words, he may engage in economic prevision and social and political planning for the results of his efforts. Or, in the third place, he may listen and watch for hints from other fields of scientific study which may react upon his own, and suggest or solve his problems. I do not attempt to give these priority. Economic and political prevision is the most difficult and precarious, because it needs a technique different from his own, and is not given by the light of Nature.

[1] Prof. Hogben: *The Retreat from Reason*, p. 3.

Specialist scientists have no particular gifts for understanding the institutional processes of social life, and the psychology of multiple and mass decisions. It is a tortuous and baffling art to transmute their exact findings into the wills and lives of unscientific millions. But quite a number engage in the pursuit and have not much greater aptitude as amateur ministers of foresight than statesmen would have in planning research. "Scientists, if in the position of politicians, would act like politicians."[1] Fewer are skilled, however, in what should be the most appropriate auxiliary to their work—the synthesizing of scientific knowledge. The more penetrating they are in their main pursuits, the less may they absorb through analogy or plain intimation from outside. We constantly hear that the average clinical application lags much farther behind the new resources of diagnosis from the laboratory than circumstances compel.[2] But it may be the other way round. The strongest hint of the presence of a particular factor—a positive element in beri-beri—was given by the clinician to the biochemist (who relied entirely on the *absence* of a particular factor, a negative element), no less than fifteen years before the biochemist took serious notice, looked for it, and found it.[3] Bacteriology and chemistry await the advance of the biochemist before they come effectively to each other's assistance. The cause and prevention of the obstinate degree of maternal mortality are objects pursued *ad hoc*, with scarcely a casual glance at the direct appeal of the eugenist to

[1] Prof. P. M. S. Blackett in *The Frustration of Science*, p. 133.

[2] Cf. Prof. Mottram's chapter on 'Medicine' in *The Frustration of Science*, p. 83, etc.

[3] Vide F. M. R. Walshe, "The Discipline of Clinical Medicine", *University College Hospital Magazine*, March 1936.

observe the natural consequences of an improvement in female infant mortality two decades earlier.[1]

I do not then pretend to dogmatize as to how far the scientist should become a social reformer. One physicist welcomes the growing sense of social responsibility, among some scientists at least, for the world the labours of their order have so largely created, though he deplores that in this field they are still utterly unscientific. Then another great authority, Sir Henry Dale, declares that it is the scientists' job to develop their science without dictating the policy for uses to which their work may be put.[2] Sir William Tilden and many others have urged that pure science makes its best advances when it bothers least about applied science, but that must not be confused with both pure and applied science not bothering about social applications and effects.[3]

I have long watched the processes by which the scientific specialist 'makes up his mind' in fields of enquiry outside his own. It seems still a matter for investigation whether the development of a specialist's thinking, on balance, impairs or improves the powers of general thinking compared with what they might otherwise have been. We do not know the kind or degree of truth that may rest in Anatole France's aphorism: "The worst of science is, it stops you thinking". Perhaps this was more subtly expressed in the simpler words of the darky mother: "If you haven't an education, you've jest *got* to use yoh brains".

My own experience is that when the attempt to

[1] Vide G. Pitt-Rivers, "The Problem of Maternal Mortality", *Eugenics Review*, 1934–35, p. 273.

[2] *Biology and Civilization.*

[3] Vide especially Sir R. A. Gregory: *Discovery*, pp. 235 *et seq.*

deal with social consequences is made, we quickly find ourselves either in the field of larger politics debating the merits of the three prevalent forms of State government, or else performing miracles with fancy currencies and their blue prints reminiscent of the chemical engineer. Mr. Julian Huxley has remarked that "scientists, with a few exceptions, are not aware of the fact that they are biased, and would be indignant if you told them that they were. And, of course, when people get indignant about anything, it is generally a sign that they have not thought scientifically on the subject." [1]

At the opposite extreme, may I quote a Mormon leader: "A good gatherer of scientific fact may be an extremely poor philosopher. The discoverer of a new land cannot always visualize the future of the new country. Nevertheless, a man who has been successful in gathering new knowledge usually feels authorized to set himself up as an interpreter of that knowledge. This often leads to real mischief." [2]

Human Aspects of Changing Industry

There are, however, some essential features of the impact which must be dealt with under any form of society and government, and with any machinery for regulating values. They involve man's abilities, his affections, and his tools, all of which have been brusquely treated in the past, and might be scientifically treated in the future. An industrial civilization without any division, and, therefore, specialization, of labour, and without tools and capital instruments, is

[1] *Scientific Research and Social Needs*, p. 32.
[2] Elder John A. Widtsoe, *In Search of Truth*.

unthinkable. Then life itself is not much worth living without social ties and the allegiances of place and kin. These three indispensable elements of the good life bring out defensive mechanisms for their protection. No one likes to see a man highly trained for a special service or specially fitted by natural aptitudes cut off from opportunity to use his powers and reduced to the level of an unskilled biped. No one likes to see the results of abstinence and specially directed labour which is embodied in a great machine or factory rendered impotent long before it has given its life's usefulness. Waste of skill and of capital are alike grave faults by which we should judge and condemn an industrial organization. Since man does not live by bread alone, if a ruthless industrial organization continually tears up the family from its roots, transferring it without choice to new surroundings, destroying the ties of kin, home and social life, of educational and recreational environments, it is far from ideal. Human labour can never be indefinitely fluid and transferable in a society that has a soul above consumption of mere commodities.

These three obstructions to change are not final and rigid limitations upon it. Men die, and their skill and home associations with them. Plant and equipment wear out. Their successor presents a natural opportunity in each of the three cases for the introduction of change in position, in aptitude, in purpose or design, without waste or human distress. The length of working life and the durability of materials mark the natural phase or periodicity of a smoothly changing society—its quanta, so to speak. But the impetus for change or the irritant has no such intervals. It proceeds from various causes: varying harvests,

changes in natural forces; changing human desires and fashions; differences in the rate of growth of population in its different parts; the collective psychological errors of optimism and pessimism in business in an individualistic society; variations in gold supplies and credit policies based thereon. All or any of these, without invoking any disturbances from the impact of scientific discovery, would serve to make adjustments necessary outside the natural phases to which I have referred, in a society with parts that are interdependent through division of labour, and localization of industry, joined by foreign trade and convenient transport. These alone would bring about a changing world with incomplete adaptations, loss of capital, and so-called frictional unemployment.

It is easy to exaggerate the adjustment necessary for the addition of invention and science to these causes of change. But with the intensification of scientific effort, and the greater subdivision of industry the possible dislocation becomes more frequent, and the ways of meeting such change of greater public importance. This field of enquiry includes widely diverse questions, for example, patent laws, invention clearing, obsolescence accountancy and costing regulation, taxation adjustments, local rating pooling, trade-union regulations, price controls, technical education, age and other discriminations in unemployment relief, transfer bonuses, pension rights, housing facilities, and more selective direction of financial support of intensive scientific research. In this neutral field which will be further discussed in a later chapter, the specialist scientist and the politician are both amateurs. It is to be covered by each extending his studies, and by

specialists who treat impact and change as an area of scientific study.

Machinery and Industry

The leading case in the problem in the popular mind is, of course, the effect of new machinery upon employment. It is so obvious, so urgent, and so difficult to meet easily.

I do not propose to go over all the ground, so old, so constantly renewed, as to its effect. It is known as an historical induction that, in the long run, it makes more employment than it destroys, in providing work in making the machinery, in reducing price so that far greater quantities of the commodity concerned may be consumed, and in enabling purchasing power to be diverted to increase other productions. It has even facilitated the creation of a larger population, which in turn has provided the new markets to work off the additional potentiality of the machinery. It does all this in 'the long run', but man has to live in the 'short run', and at any given moment there may be such an aggregation of unadjusted 'short runs' as to amount to a real social hardship. Moreover, it comes in this generation to a people made self-conscious by statistical data, repeated widespread at frequent intervals, and to a people socially much more sensitive to all individual hardship and vicissitude which is brought about by communal advance.

Probably those who have little knowledge of industrial history can never realize how the story repeats itself, and few points in the popular indictment to-day are really new.

The introduction of machinery has been for 300

years accompanied by the same hostile arguments, for the immediate effects in unemployment are much more obvious and human than the countervailing employment given by the released purchasing power, which may occur in some other place or country. Illustrations may be found all the way from Queen Elizabeth's sentiments on stocking-knitting machinery to the Luddite riots, and the eight looms per weaver of to-day.

Lee brought out an epoch-making invention for knitting stockings, which was the only considerable British invention before the eighteenth century, and Queen Elizabeth exclaimed : " I have too much regard for my people who obtain their bread by knitting ". So Lee took his machine to France.

An Historic Example : the Advent of the Stage-coach

But in the literature of the whole series, nothing can outdo, for detailed economic jeremiad and precise calculation of woe, a contemporary examination of the effect of the introduction of the stage-coach in the middle of the seventeenth century upon the post-horse industry and all that depended upon it. It is contained in a rare book entitled *The Grand Concern of England*, 1673, which covers a variety of discontents, and I cannot find that any attention has ever been drawn to it. It is so striking that I must quote at length :

> These Coaches and Caravans are one of the greatest mischiefs that hath hapned of late years to the Kingdom, mischievous to the Publick, destructive to Trade, and prejudicial to Lands.

First, by destroying the Breed of good Horses, the Strength of the Nation, and making Men careless of attaining to good Horsemanship, a thing so useful and commendable in a Gentleman.

Secondly, by hindring the Breed of Watermen, who are the Nursery for Seamen, and they the Bulwark of the Kingdom.

Thirdly, by lessening of his Majesties Revenues.

For the first of these; Stage-Coaches prevent the breed of good Horses, destroy those that are bred, and effeminate his Majesties Subjects, who having used themselves to travel in them, have neither attained skill themselves, nor bred up their Children to good Horsemanship, whereby they are rendred uncapable of serving their Countrey on Horseback, if occasion should require and call for the same; for, hereby they become weary and listless when they ride a few miles, and unwilling to get on Horseback; not able to endure Frost, Snow, or Rain, or to lodg in the Fields; and what reason, save only their using themselves so tenderly, and their riding in these Stage-Coaches, can be given for this their inability?

What encouragement hath any Man to breed Horses whilst these Coaches are continued? There is such a lazy habit of body upon Men, that they, to indulge themselves, save their fine Cloaths; and keep themselves clean and dry, will ride lolling in one of them, and endure all the Inconveniences of that manner of travelling rather than ride on Horseback; So that if any Man should continue his Breed, he must be one that is a great lover of them, and resolve to keep and please his own fancy with them; otherwise most certainly he (as most Breeders already have done) will give over his breeding.

There is not the fourth part of Saddle-Horses, either bred or kept now in *England*, that was before these Coaches were set up, and would be again if they were suppressed. Nor is there any occasion for breeding or keeping such Horses, whilst the Coaches are continued.

For, will any Man keep a Horse for himself and another for his Man, all the year for to ride one or two Journeys, that at

pleasure, when he hath occasion, can slip to any place where his business lies, for two, three or four shillings, if within twenty miles of London, and so proportionably into any part of England? No, there is no Man, unless some Noble Soul, that scorns and abhors being confined to so ignoble, base and a sordid way of travelling, as these Coaches oblige him unto, and who prefers a publick Good before his own ease and advantage, that will breed or keep such Horses. Neither are there near so many Coach-Horses either bred or kept in England now, as there were Saddle-Horses formerly, there being no occasion for them, the Kingdom being supplyed with a far less number. For, formerly, every Man that had occasion to travel many Journeys yearly, or to ride up and down, kept Horses for himself and Servants, and seldom rid without one or two Men; but now since every Man can have a passage into every place he is to travel unto, or to some place within a few miles of that part he designs to go unto, They have left keeping of Horses, and travel without Servants; And York, Chester and Exeter Stage Coaches, each of them with forty Horses a piece, carry eighteen Passengers a week from London to either of these places; and in like manner as many in return from these places to London; which comes in the whole to 1872 in the year. Now take it for granted, That all that are carried from London to those places, are the same that are brought back, yet are these 936 Passengers carried by forty Horses; Whereas, were it not for these Coaches, at least 500 Horses would be required to perform this Work. Take the short Stages, within twenty or thirty miles of London, each Coach with four Horses carries six passengers a day, which are 36 in a week, 1872 a year; If these Coaches were supprest, can any Man imagine these 1872 Passengers and their Servants, could be carried by four Horses? Then reckon your Coaches within ten miles of London, that go backward and forward every day and they carry double the number every year; and so proportionably your shorter Stages within three, four or five miles of London.

There are Stage-Coaches that go to almost every Town within 20 or 25 miles of London, wherein Passengers are

carried at so low Rates, that most persons in and about London, and in Middlesex, Essex, Kent and Surry, Gentlemen, Merchants and other Traders that have occasion to ride do make use of; some to keep Fairs and Markets; others to visit Friends, and to, and from their Countrey-houses, or about other business, who before these Coaches did set up, kept a Horse or two of their own, but now have given over keeping the same; so that by computation there are not so many by ten thousand Horses kept now in these Parts, as there were before Stage-Coaches set up: By which means breeding of good Pad-Nags is discouraged, and Coach Horses that are bred, by cruelty and ill usage of Stagers are destroyed.

Then he goes on to show how the Watermen have been ruined from Gravesend to Maidenhead, and how the Excise is prejudiced:

· It prejudiceth his Majesty in his Revenue of Excise: for now four or five travel in a Coach together, and twenty or thirty in a Caravan, Gentlemen and Ladies, without any Servants, consume little Drink on the Road, yet pay as much at every Inn, as if their Servants were with them, which is the Tapsters gain and his Majesties Loss: But if Travellers would, as formerly they did, Travel on Horseback, then no Persons of Quality would ride without their Servants: And it is they that occasion the Consumption of Beer and Ale on the Roads, and so would advance his Majesties Revenue. I know it will be Objected, There are as many People now as will be when Coaches are down, and they drink where ever they are; Therefore no matter whether they drink at Home or on the Road, since the Consumption will be the same; How can the Kings Revenue then be advanced by Servants travelling with their Masters or Mistresses, more than it is already? The answer is plain; at home they drink small or strong drink brewed by their Masters that pay no Excise, but whatever they drink at Inns pays the King's duties; And all Innkeepers do declare that they sell not half the drink, nor pay the King ½ the Excise they did before these coaches set up.

But it is when he gets to the dependent and ancillary trades affected that he excels himself:

These Coaches and Caravans are destructive to the Trade and Manufactories of the Kingdom, have impoverished and ruined many thousands of Families, whose subsistence depended upon the Manufacturing of Wool, and Leather, two of the staple-Commodities of the Kingdom: For, before these Coaches were set up, Travellers rode on Horseback, and men had Boots, Spurs, Saddles, Bridles, Sadle-clothes, and good riding Suits, Coats and Cloaks, Stockings and Hats; Whereby the Wool and Leather of the Kingdom was consumed, and the poor people set at work by Carding, Combing, Spinning, Knitting, Weaving, Fulling: And your *Cloth Workers*, *Drapers*, *Taylors*, *Saddlers*, *Tanners*, *Curriers*, *Shoemakers*, *Spurriers*, *Lorayners*, *Felt-makers*, had a good imploy, were full of work, got money, lived handsomely, and help'd with their Families to Consume the Provisions and Manufactures of the Kingdoms; But by means of these Coaches, these Trades, besides many others depending upon them, are become almost useless; and they, with their Families, reduced to great necessity; insomuch, that many thousands of them are cast upon the Parishes wherein they dwell, for a Maintenance. Besides, it is a great hurt to the *Girdlers*, *Swordcutters*, *Gunsmiths and Trunkmakers*; Most Gentlemen, before they travelled in their Coaches, using to ride with Swords, Belts, Pistols, Holsters, Portmantues and Hat-cases, which in these Coaches they have little or no occasion for: For, when they rode on Horseback, they rode in one Suit, carried another to wear when they came to their journeys end, or lay by the way: But in Coaches, a Silk-Suit, and an Indian-Gown with a Sash, Silk-Stockings, Beaver-Hats men ride in, and carry no other with them, because they escape the wet and dirt, which, on Horseback, they cannot avoid; Whereas, in two or three Journeys on Horseback, these cloaths and hats were wont to be spoiled: Which done, they were forced to have new very often; and that encreased the Consumption of the Manufactures and the imployment of the Manufacturers, which travelling in Coaches doth no way do. And if they were Women that travelled,

they used to have Safeguards, and Hoods, Side-Saddles and Pillions, with Strappins, Saddle or Pillion-cloths, which (for the most part) were either laced or imbroydered; to the making of which there went many several trades, seeing there is not one Side-Saddle with the furniture made, but before it be furnished, there are at least thirty several trades, have a share in the making thereof, most of which are either destroyed, or greatly prejudiced by the Abatement of their Trade: Which being bred unto, and having served seven years Apprentiship to learn, they know not what other course to take for a Livelyhood. And besides all these inferior Handy-Craftsmen, there are the Mercers, Silkmen, Lace-men, Milliners, Linnen and Woollen Drapers, Haberdashers, and divers other Eminent Trades, that receive great prejudice by this way of Travelling: For the Mercers sold Silk and Stuff in great quantities for Safeguards, Hoods, and Riding Clothes for Women; by which means the Silk-Twisters, Winders, Throseters, Weavers and Dyers, had a fuller Imployment, the Silkmen sold more Lace and Imbroidery, which kept the Silver-Wyre-Drawers, Lace-Makers and Imbroyderers. And at least ten Trades more were imployed: The Linnen-Draper sold more Linnen, not only to Sadlers to make up Sadles, but to Travellers for their own Use, nothing wearing out Linnen more than riding. Woollen-Drapers sold more cloth than now; Sadlers used, before these Coaches were set up, to buy 3 or 400 L. worth of cloth apiece in a year, nay some Five hundred and a Thousand pounds worth, which they cut out into Saddles and Pillion-Cloths; though now there is no Sadler can dispose of One Hundred pounds worth of Cloth in a year in his Trade. The Milliners and Haberdashers, they also sold more Ribbons, Gloves, Hoods, Scarfs, and other things belonging to their Trade; the dust, dirt and rain, and riding on Horseback, spoiling and wearing them out, much more than travelling in a Coach; and on Horseback these things were apter to be lost than in a Coach.

Then he goes into morals and ethics:

For passage to London being so easie, Gentlemen came to

London oftner than they need, and their Ladies either with them, or having the Conveniences of these Coaches, quickly follow them. And when they are there, they must be in the Mode, have all the new Fashions, buy all their Cloaths there and go to Plays, Balls and Treats, where they get such a habit of Jollity, and a love to Gayety and Pleasure, that nothing afterwards in the Countrey will serve them, if ever they should fix their minds to live there again ; But they must have all from London, whatever it costs.

After reviewing the effects on the better distribution of money in the country, on the rents of lands, urban and farm, through meat and pasture consumption, he proceeds to show that after all, the travel by coach is much dearer in the long run, even to the one who thinks he is clever in doing it, and then, what of comfort and convenience !—

Travelling in these Coaches can neither prove advantagious to Men's Health or Business : For, what advantage is it to man's Health, to be called out of their Beds into these Coaches, an hour before day in the morning, to be hurried in them from place to place, till one hour, two, or three within night ; insomuch that after sitting all day in the Summer time stifled with heat, and choked with the dust ; or the Winter time starving and freezing with the cold, or choked with filthy Fogs, they are often brought into their Inns by Torchlight, when it is too late to sit up to get a Supper ; and next morning they are forced into the Coach so early, that they can get no Breakfast. What addition is this to men's Health or Business, to ride all day with strangers, oftimes sick, ancient, diseased Persons or Young Children crying ; to whose humours they are obliged to be subject, forced to bear with, and many times are poysoned with their nasty scents and cripled by the crowd of the Boxes and Bundles. Is it for a Mans Health to travel with tired Jades. . . .

I have digressed, with this old-world example,

because it contains most of the contentions of principle since advanced with strange reiteration.

The 'Balance of Innovation' and Population

We can now return to the present day to analyse a little more closely the effects of novelty. There are two important aspects of the change induced by science which are insufficiently realized, and which make a profound difference to the direction of thought and enquiry. The first I will call the 'balance of innovation' and the second the 'safety-valve' of population.

Inasmuch as all economic production creates real vested interest in a location or a skill devoted to it, and every scientific innovation alters the centre of gravity of collective demand, every such scientific change disturbs an economic equation. That equation for human life may often be richer ultimately, but the pain or waste of disturbance has to be debited to the gain, before the net balance is progress. For the time being, the balance may be net loss, the price paid for to-morrow. If to-morrow is continually postponed, because it, in its turn, is redisturbed, and the economic to-morrow never comes, it is some jam yesterday, lots of jam to-morrow, but never jam to-day. Wastes of absorption will be at a minimum in certain conditions, which are related to the wearing life of existing assets and places, and to the rate of flow of new skill into new directions. The orderly absorption of innovation into economic progress, apart from improvements in the non-economic factors of such progress, depends upon two kinds of balance.

The changes brought by science in economic life

may be broadly classified as the ' work creators ' and the ' work savers '. The latter save time, work, and money by enabling the existing supply of particular commodities to be produced more easily, and therefore at lower cost, and finally at lower prices. People can spend as much money as before upon them and get larger quantities, or they can continue to buy their existing requirements at a lower cost. In this second event they ' save money ' and their purchasing power is released for other purposes. By a parallel process, producing or labouring power is released through unemployment. The released working force and released purchasing power can come together again in an *increased* demand for other products which, to this extent, have not been hitherto within effective demand. The supply of this increase may go part or all of the way to absorb the displaced labour. But this process takes time, and the labour displaced is not at once of the right kind or in the right place. More important, however, is the invention of quite new objects of public demand, which may be desired in addition to the supply of old ones. This brings together released labour and released purchasing power in the most decisive way. In other words, we are seeking a balance between two classes of scientific discovery, that which accelerates or makes easier the production of existing economic goods, and that which creates new kinds of economic satisfactions—the derivative and the direct. Let us suppose that in a static society a million people are employed making boots, and that the gramophone has not been invented. Then let a labour-saving device be invented, such that the same quantity of boots can be made by half the workers, and boots are half the price. Assuming that

the demand for boots is quite inelastic, and no more are wanted, there is potential unemployment for half a million people, and the whole population has now reserve unspent purchasing power, saved on cheaper boots. The gramophone is introduced, employing the potentially unemployed, and absorbing the reserve or released purchasing power. The progress of the past hundred years has been essentially of this order, and innovation has enabled purchasing power to be released for new spending, first, upon far *more* of the same article at the reduced price ; second, upon more of other existing goods ; and, third, upon entirely new kinds of satisfaction, bicycles or radio sets. In this connection it must be remembered that an old article may be so transformed in degree as to be equivalent to a change in kind—the silk stocking and feminine footwear are cases in point. Now even if these two classes of innovation, direct and derivative, are in balance, the process of absorbing them will give rise to economic growing pains and temporary dislocations of capital and employment, but the gains will rapidly outweigh the disadvantages. But when they are not in balance, the process is more painful, and the debit to be set against progress very much greater.

The most orderly and least disturbing phases of progress will thus be found when these two types of innovation are reasonably balanced.

The problem in question, in the direct and the derivative, is not, however, so simple in practice, for the sum total of the effect of derivative innovations (creating technological unemployment) ought to be balanced by the sum total of direct innovations or increased demand for other products (new and ex-

panded employment). But many direct innovations are not additive, they are substitutional, and destroy the need for old commodities. If combs are made from celluloid, and dishes from papier mâché or pyrex, they will certainly not create a wholly additional demand or employment—there will be a displacement of the old types in metal or bone combs or china dishes. Artificial silk displaces some cotton consumption, radio may displace some types of musical instruments. Recently the German production of pianos and guitars has been at a very low percentage of capacity, and part of this has been made good by the demand for radio sets. This substitution goes into rival *classes* of utility also, and a radio set may be a real substitute for a billiard table, and oil may be the enemy of hops if cheap bus-riding supplants long sittings in public-houses. These substitutions may be gradual enough to be absorbed as a normal feature of progress, but if they are very rapid and coincide with certain other economic disturbances they may be very distressing. By ' normal ' I mean such as can be coped with by the direction of new labour entering industry or new capital spent on renewals, leaving the contractions to take place by natural age attrition, without unemployment or premature obsolescence—for the moment this is the optimum point of change.

(In so far as we are assuming these changes are not mere curiosity or novel betterment, the argument so far, no doubt, begs the question of the meaning of ' progress ', and assumes that silk stockings and fine shoes represent a ' higher ' standard of life than black homespun woollens and rough boots—a doctrine that is not acceptable to Mr. de Valera for example. But as we are not entering the field of morals or ethical aims,

we are obliged to assume that those objects which are actually the subject of average human desire must be given their economic significance accordingly, and not attempt to solve the larger problem simultaneously. In this sense such a mechanical invention as the totalisator must take its place in 'progress' at this stage.)

The lack of balance between derivative and direct innovation may be due, of course, to a terrific drive and rapidity in scientific discovery of the industrial type, but it is only fair to say that the excess of one may be due to causes on the economic side. If for purely monetary reasons, the gold standard, etc., the purchasing power of money is continually increasing through falling prices, and, with the current inability to change the money-totals of wages and other costs, real wages are rising, it becomes increasingly possible to substitute innovations of machinery for hand labour or complex processes for simple. A change that was not worth making on a balance of old wage-costs against new capital costs in 1923, became well worth making by 1932—a point of lower prices—and indeed imperative, if any profits were to be preserved. Hence the almost artificial pressure which a rigid monetary system may bring to bear towards the over-rapid application of new methods and creation of unemployment.

Let us suppose that a given output is produced in 1923 at a cost of £10,000, being £8000 in wages and £2000 in interest on capital in machinery, at 5 per cent. Sales take place for £11,000. New machinery would enable it to be made for £10,000, being £2000 in wages and £8000 in interest. But this is not worth doing. Let the price of commodities fall 25 per cent—then the proceeds fall to £11,000 − 2750 = £8250, and manu-

facture must stop, and all are then unemployed. But the new machinery proposition is looked at again, and its cost having come down to the equivalent of £8000 – 25 per cent = £6000 per annum, the total new costs with wages unchanged at £2000 are £8000, and the proposition is worth while taking up again. It has apparently put 75 per cent of the wage-earners out of work, though actually the number is less because of those engaged in making the machinery. But the alternative was that they would be all displaced.

The Factor of Obsolescence

The second kind of balance which is vital to economic progress and which may be ruined by over-rapid innovation is that between obsolescence and depreciation. To be effective nearly all scientific advance for economic progress has to be embodied in capital forms, more and more elaborate, large and costly. The productivity of such apparatus and plant per man involved becomes greater, and even allowing for the men employed in making the machinery or process, the total satisfaction is continually produced with less and less human effort. Now it used to be said of British machinery that it was made good enough to last for ever and long after it became old-fashioned, whereas American machines were made to be worn out much earlier, and were thus cheaper, and they could be immediately replaced by capital assets containing the latest devices. If the period of physical life and fashionable life can be made to correspond, there is greatest economy and security of capital. But if the expensive embodiment of the latest science can be outmoded and superseded long before it is worn out,

there is waste of capital, loss of interest, and resultant insecurity of business and investment. The factor of physical safety alone means that each embodiment must be really durable, even if roughly finished, and, therefore, it is impossible wholly to reduce physical life to probable 'obsolescent' life. In this way an over-rapid series of innovations may mean the scrapping or unprofitability of much excellent capital for very small marginal gains. A responsible socialist community would see each time that the gain was worth while, but competitive individuals are only just beginning to get collective responsibility. Suppose the "Queen Mary" attracts a profitable contingent for two years only, when a lucky invention in a new and rival vessel attracts all her passengers at a slightly lower fare. Here is progress in one typical sense, but the small net advantage to be secured by individuals as free lance *consumers* may be dearly purchased by large dislocations or loss of capital reacting even upon those same individuals as *producers*.

Now, if the innovation were very striking, and were reflected in working costs, the margin of difference between the old working costs and new working costs may be large enough to pay interest on the new capital employed, and also to amortize the cost of the unrealized life of the asset displaced. A locomotive may have many years of useful life left, but a new type *may* provide a margin by lower working costs not only sufficient to make one adopt it on normal renewal, but also to pay for the premature scrapping of the old type. The major part of modern innovation is, however, of the type which does *not* pay the costs of obsolescence and proceed by orderly and natural physical renewal or substitution.

A similar type of argument applies to the capital expenditure generally of all kinds on a district, which can be amortized over the whole economic activity of that area, such as a colliery area, but which is wasted if a dislocation occurs by the adoption of some innovation stimulating rival activity in another place. Consider the effect upon Lancashire of the discovery that the boasted natural advantage of humidity for spinning and weaving can be produced artificially elsewhere, and, moreover, to a better degree of uniformity.

The rate of introduction of new methods and the consequent impact upon employment may depend upon the size and character of the business unit. If all the producing plants for a particular market were under one control, or under a co-ordinated arrangement, the rate of introduction of a new labour-saving device will be governed by the simple consideration already referred to. It can be introduced with each renewal programme for each replacement of an obsolete unit, and therefore without waste of capital through premature obsolescence. But this applies only to small advantages. If the advantages are large, the difference in working costs for a given production between the old and the new types will be so considerable as to cover all charges as indicated above. In neither case, then, is there any waste of capital, and the absorption of the new idea is orderly in time. Again, the obsolescence occurring within a single establishment dominating supply can be absorbed into current costs. Owen Young said recently: "Broadly speaking, there has not been a time during the past fifty years when anything manufactured by the General Electric Company was not, to some extent at least,

obsolete by the time that it was put in service." [1] It is quite clear that this process in the hands of a single unit can be reflected as a general part of continuous costs of production, and it is not necessary to assume that at no time in the fifty years could the Company make profits and pay dividends because it was meeting obsolescence payments.

But it is quite otherwise if the units are in different ownerships. Excess capacity can quickly result from new ideas. A new ship or hotel or vehicle with the latest attractions of scientific invention, quite marginal in their character, may obtain the bulk of the custom, and render half empty and, therefore, half obsolete, a unit built only a year before. The old unit has to compete by lower prices, and make smaller profits. The newer unit is called upon to bear no burdens in aid of the reduced capital values of the old. It may be that the enhanced profits of the one added to the reduced profits of the other make an average return upon capital not far different from the average that would result in a community where orderly introduction on a renewal basis is the rule. Or perhaps the community gets some of its novelties rather earlier under competitive conditions, and pays a higher rate of interest for them as a net cover for the risks of obsolescence. Waste of capital would be at a minimum if the 'physical' life before wearing out were as short as the 'social' life of the machine. To make a thing so well that it will last 'for ever' is therefore nothing to boast about if it will be out of fashion in a few years.

[1] 50th Anniversary meeting of the General Electric Company at Schenectady.

The Factor of Population

A natural increase of population is the best shock absorber that the community can possess, especially if accompanied by an extension of territory such as the United States enjoyed in the constant westward movement of the frontier in the nineteenth century, or Britain in the period of overseas emigration. A moment's reflection will show why this is the case. Assume that 1,000,000 units of a commodity are made by 100,000 men, and that there is an increase of population of 2 per cent per annum, so that in five years 1,100,000 units will be consumed and employ 110,000 men. Now assume the introduction of a new invention which enables 1,100,000 units to be made by 100,000 men. There will be no displacement of existing labour, but only a redirection of new and potential labour from that industry to other fields. Again, a considerable reduction in demand *per head* can be sustained without dislocation, if the actual aggregate of production demanded is maintained by increasing numbers. The affected industry can remain static and need not become derelict. New entrants to industry will be directed to those points where purchasing power, released through labour-saving devices, is creating new opportunity with new products. New capital is also naturally directed into the new channels instead of into additions to the old industry.

Now the problem before all Western industrial countries is the fact that their populations are shortly becoming stationary (and then will begin to decline noticeably) and this safety-valve of increasing population will no longer be available. Every transfer of *per capita* purchasing power to new directions must

then be a definite deduction from the old directions, no longer made good by the steady increase in the numbers demanding less per head from those old sources. The impact of science upon a stationary population is likely, *ceteris paribus*, to be much more severely felt than upon a growing population, because the changes of direction cannot be absorbed by the newly directed workers. Of course, the effects of a static population can be mitigated if the *per capita* income is increasing, because a new direction of demand can be satisfied out of the additional purchasing power without disturbing the original directions of demand provided by the original purchasing power.

The change from a growing to a static or declining population is only one type of difficulty. While the aggregate is altering but slowly, the parts may be changing rapidly. Thus, in England and Wales, 40·4 millions in 1937 becomes 40·6 in 1942, 40 in 1947, 39·8 millions in 1952, 38·9 in 1957, and 37·5 in 1962.[1] But the children aged sixteen years—which age I take because of its influence on schools, teaching and industrial entry—have been estimated, taking those in 1937 as 100, to be 85 in 1942, 73 in 1952, and 62 in 1962.[2] A fall of this magnitude means that industries and institutions dependent upon the present numbers must not be merely static but actually regressive. On the other hand, the older people from sixty-five to seventy-four years will increase in this ratio—100, 113, 127, and 133. These problems of static populations at home are accentuated by the possibility of a similar tendency abroad, and need thought in advance. The

[1] Norman Wilson, *Expected Population Changes and their Effect upon Social Services*, p. 9.

[2] *Ibid.* p. 31.

Australian farmer is more affected by the British conditions of population than by his own. Perhaps birth control for people demands ultimately birth control for their impedimenta.

We have thus the first difficulty, that of a static total demand, the second, that the safety-valve of new industrial entrants is becoming smaller, but a third difficulty comes from the present tendency of that class. A stationary elderly population must be very inflexible to change, but a stream of new young life, even if it is to be smaller, would give the opportunity for just that change of direction, in training and mobility, which society needs. But unfortunately, in practice this does not now seem to be very adaptable. For we learn from certain Unemployment Insurance areas that while the older people will willingly take jobs at wages a few shillings in excess of the unemployment relief, the younger men are more difficult. For every one who will accept training under good conditions to fit him for eligible work, ten may refuse, and the number who will not go any distance to take work at good wages is also in excess of those who do. Attachment to place for older people is understandable, and has been accentuated by housing difficulties—one learns of miners unemployed in a village where the prospects of the pit reopening are negligible, while at the same time, only twenty miles away, new miners are being created by attraction from agriculture to more extended workings in their area. The very social machinery which is set up to facilitate change or to soften dislocation aggravates the evil. The first two difficulties are unalterable. This third difficulty is a subject for scientific examination.

Industrial Disequilibrium

So much for the effect of change of any kind upon employment. Now let us narrow this to scientific changes. At any given moment the impact of science is always causing some unemployment, but at that same time the constructive additional employment following upon past expired impacts is being enjoyed. But it is easy to exaggerate the amount of the balance of net technological unemployment. For industrial disequilibrium arises in many ways, having nothing whatever to do with science. Changes of fashion, exhaustion of resources, differential growth in population, changing duties and tariffs, the psychological booms and depressions of trade through monetary and other causes, all disturb equilibrium, and, therefore, contract and expand employment in particular places.

Our analytical knowledge of unemployment is bringing home the fact that, like capital accumulation, it is the result of many forces. A recent official report indicated that a quite unexpected amount or percentage of unemployment would be present even in boom times. We know already that there may be a shortage of required labour in a district where there is an 8 or 10 per cent figure of unemployment. So in Great Britain there may well be a million unemployed in what we should call good times—it is part of the price we pay for the high standard of life secured by those who retain employment. For a level of real wage may be high enough to prevent everyone being employable at that wage—though that is by no means the whole economic story of unemployment. Of this number probably 200,000 would be practically unemployable

on any ordinary basis—the 'hard core' as it is called. Perhaps seven or eight hundred thousand form the perpetual body, changing incessantly as to its unit composition, and consisting of workers undergoing transition from job to job, from place to place, from industry to industry, with seasonal occupations—the elements of 'frictional' unemployment through different causes. Out of this number I should hazard that not more than 250,000 would be unemployed through the particular disturbing element of net scientific innovation.

This is the maximum charge that should be laid at the door of science, except in special times, such as after a war, when the ordinary application of new scientific ideas day by day has been delayed, and all the postponed changes tend to come with a rush. At any given moment, of course, the technological unemployment that could be computed from the potentiality of new processes over displaced ones appears to be much greater. But such figures are *gross*, and from them must be deducted all recent employment in producing new things or larger production of old things, due to science. If we are presenting science with part of the responsible account of frictional unemployment at any moment, it will be the total technological reduction due to new processes, and displacement due to altered directions of demand, less the total new employment created by new objects of demand. This has to be remembered when we are being frightened by the new machine that does with one man what formerly engaged ten.

Scientists often look at the problem of practical application as if getting it as rapidly as possible were the only factor to be considered in social advantage,

and this difference in the position of monopoly or single management in their ability to 'hold up' new ideas is treated as a frustration in itself. Thus it has been said: "the danger of obsolescence is a great preventative of fundamental applications to science. Large firms tend to be excessively rigid in the structures of production."[1] Supposing that the obsolescence in question is a real factor of cost, it would fall to be reckoned with in the computation for transition, whatever the form of society, and even if the personal 'profit' incentive were inoperative. It cannot be spirited away. A customary or compulsory loading of costs for short life obsolescence would retard rapid competition of novelties economic to a narrow range of individuals but uneconomic to the community as a whole, and could be scientifically explored as indicated in a later chapter.

The Charge for Displaced Labour

Under an individualistic form of society, it is difficult to alter the social technique of change, and to make its credits really pay for the debits, and make all the people who gain by the profits on new capital pay also for the losses on prematurely displaced capital, or the gainers by cheapness and variety pay the human costs of unemployment and no longer wanted skill. The *basic economic* reason for social unemployment relief is not the humanitarian argument of social obligation to meet distress, *or* the argument against revolution, but the plain argument that (*a*) the gainers by innovation, the 'consumers' of it, should bear the

[1] J. D. Bernal on 'Science and Industry' in *The Frustration of Science*, p. 72.

losses of innovation; and (*b*) that those who enjoy collectively the benefits of intricate division of labour and freedom of consumer's demand should pay the social costs of it.

Let us look, therefore, at displaced labour and the costs of it. If the effect of diversion of demand through invention is to reduce the scope or output of particular industries or concerns in private management, they have no option but to reduce staff. If the pressure is not too great, or the change too rapid, this does not necessarily result in dismissals, for the contraction of numbers may be made by not filling up, with young people, the vacancies caused by natural wastage, through death and retirement. But where dismissals are inevitable, re-engagements may take place quickly in the competing industries, otherwise unemployment ensues. Any resulting burden does not fall upon the contracting and unprofitable industry —it has troubles enough of its own already. Nor is it put upon the new and rising industry, which is attracting to itself the transferred profits. In the abstract, it might be deemed proper that before the net gains of such an industry are computed or enjoyed it should bear the burdens of the social dislocation it causes by its intrusion into society. In practice, it would be difficult to assess its liability under this head, and in fact even if it could be determined, new industries have so many pioneer efforts and losses, so many failures, so many superseded beginnings, that it might well be bad social policy to put this burden upon them, for they would be discouraged from starting at all if they had to face the prospect of such an overhead cost whatever their trading results.

It would, of course, be theoretically possible to put

a special levy on those new industries that turned out to be profitable, and to use it to relieve the social charges of dislocation of labour. But much the same argument could be used for the relief of obsoletism of capital. The distinction would, however, be that in the case of the capital it could be urged that the investor should have been wide enough awake to see the possibilities of the rival, whereas the worker, induced to take up employment in such a superseded industry, was a victim, and could not be expected to avoid it by prevision. In any event, the prevailing sentiment is rather to encourage developing industries than to put special burdens upon them, in order that the fruits of science may be effectively enjoyed by society with as little delay as possible.

In the upshot, therefore, the injuries to labour, though not to capital, are regarded as equitably a charge to be borne by society in general through taxation, and to be put upon neither the causing nor the suffering business unit.

It may well be assumed that, taken throughout, the gains of society as a whole from the rapid advance are ample enough to cover a charge for consequential damages. But society is not consciously doing anything to regulate the rate of change to an optimum point in the net balance between gain and damage.

The willingness of society to accept this burden is probably mainly due to the difficulty of fairly placing it, for we find that when it *can* actually be isolated and the community happens fortuitously to have a control, or the workers a power to induce, it will be thrown, not upon the attacking industry, if I may so call it, but upon the defender. Thus in the United States recently, the price of consent to co-ordinating

schemes made for the railroads to reduce operating expenses has been an agreement on this very point. If staff is dismissed, as it was on a large scale in the depression, because of fewer operations and less stock in consequence of reduced carriage through the smaller volume of trade, or through road and sea competition, no attempt was made to put any of the social cost upon the railroads, and the dismissed staff become part of the general unemployed. But if the self-defence of the companies against competition takes the form of co-operation with each other to reduce operations and stock and, therefore, costs, any resultant dismissals are made a first charge upon them.

The agreement is elaborate, and has the effect of preventing any adjustments which an ordinary business might readily make when it throws the burden on society, unless those adjustments yield a margin of advantage large enough to pay for their particular special effects. Thus the rapidity of adjustment to new conditions, not to meet the case of higher profits to be made at the expense of workers, but rather to obviate losses through new competition, is materially affected, and a brake is put upon the mechanism of equilibrium in this industry which does not apply to its rivals, or to any others where the power exists to throw it upon the community. A similar provision exists in the Argentine, and it is imposed by Act of Parliament in Canada, but as one of the concerns is nationally owned, and the current losses fall upon the national budget, its charge is really socially borne in the end.

In Great Britain such provisions were part of the amalgamation project of 1923, and of the formation

of a single transport authority in London in 1933, and, therefore, did not arise through steps taken to meet new factors of competition. But the opportunity for their imposition came when rights to road powers and rights to pooling arrangements were sought by the railways—both of them adjusting mechanisms to minimize the losses due to the impact of new invention—and this was clearly a specialized case of keeping the burdens off society. In the case of the electricity supply amalgamation of 1933, brought about for positive advantages rather than in defence against competition, similar provision was made, and parliamentary powers for transfers to gas and water undertakings, also not defensive against innovation, have been accompanied by this obligation. In the case of such uncontrolled businesses as Imperial Chemicals and Shell Mex, rationalizing to secure greater profits, rather than fighting rearguard actions to prevent losses, obligations to deal with redundancies have been voluntarily assumed. In such cases the public obloquy of big business operations inimical to society can be a negative inducement, but some freedom from radical competition in prices provides a positive power to assume the burden initially, and pass it forward through price to consumers, rather than back against shareholders. The third case, however, of making it a net charge on the improved profits, is quite an adequate outlet. If the principle of putting this particular obstacle in the way of adjustments to meet new competition (as distinct from increasing profits) is socially and ethically correct, it is doubtful whether it is wisely confined to cases where there is quite fortuitously a strategic control by public will.

The Cost of Quickness or Delay

It will be clear that the difference between the introduction by purely competitive elements involving premature obsolescence and unemployment, and by delayed action, is a cost to society for a greater promptness of accessibility to novelty. The two elements of capital and labour put out of action would have supplied society with an extra quantity of existing classes of goods, but society prefers to forgo that for the privilege of an earlier anticipation of new things. I estimate this price to be of the order of 3 per cent of the annual national income. But when we speak of social advantage, on balance, outweighing social cost, we dare not be so simple in practice. If the aggregate individual advantage of adopting some novelty is $100x$ and the social cost in sustaining the consequential unemployed is $90x$, it does not follow that it is a justifiable bargain for society. The money cost is based on an economic minimum for important reasons of social repercussions. But the moral effects of unemployment upon the character and happiness of the individual escape this equation altogether, and are so great that we must pause upon the figures. What shall it profit a civilization if it gain the whole world of innovation and its victims lose their souls ?

So far I have treated the problem of innovation as one of uneconomic rapidity. But there is another side —that of improvident tardiness. Enormous potentialities are seen by scientists waiting for adoption for human benefit, under a form of society quicker to realize their advantage, readier to raise the capital required, readier to pay any price for dislocation, and

to adjust the framework of society accordingly. A formidable list of these potentialities can be prepared, and there is little doubt that with a mentality adjusted for change, society could advance much more rapidly. But there is a real distinction between the methods of adopting whatever it is decided to adopt, and the larger question of a more thoroughgoing adoption. In proportion as we can improve the impact of the present amount of innovation, we can face the problem of a larger amount or faster rate. Unless most scientific discoveries happen to come within the scope of the profit motive, and it is worth someone's while to supply them to the community, or unless the community can be made sufficiently scientifically minded to include this particular demand among their general commercial demands, or in substitution for others, nothing happens—the potential never becomes actual. It has been computed that a benevolent dictator could at a relatively small expense, by applying our modern knowledge of diet, add some two inches to the average stature, and seven or eight pounds to the average weight of the general population, besides enormously increasing their resistance to disease.[1] But dictators have disadvantages, and most people prefer to govern their own lives indifferently, rather than to be ideal mammals under orders. To raise their own standard of scientific appreciation of facts is the better course, if it is not utopian. It has been clear for long enough that a diversion of part of the average family budget expenditure from alcohol to milk would be of great advantage. But it has not happened. If the individual realized the fact, it certainly might happen.

[1] Harold Deane, 'The Cultivation of Drugs', *Quarterly Journal of Pharmacy*, 1936, p. 338.

It is ironically remarked that the giving of free milk to necessitous children, with all the net social gain that it may bring about, has not been a considered social action for its own sake, but only the by-product emergency of commercial pressure—not done at the instance of the Ministry of Health or the Board of Education, but to please the Milk Marketing Board [1] by reducing the surplus stocks of milk in the interests of the producer !

Planning and its Limitations

Scientists see very clearly how, if politicians were more intelligent, if business men were more disinterested, and had more social responsibility, if governments were more fearless, far-sighted, and flexible, our knowledge could be more fully and quickly used to the great advantage of the standard of life and health—the long lag could be avoided, and we should work for social ends. It means, says Dr. Julian Huxley, "the replacement of the present socially irresponsible financial control by socially responsible bodies". Also, it obviously involves very considerable alterations in the structure and objectives of society, and in the occupations and preoccupations of its individuals.

Now a careful study of the literature of planning shows that it deals mainly with planning the known and scarcely at all with planning for changes in the known. Although it contemplates 'planned' research, it does not generally provide for introducing the results of new research into the plan, and for dealing with the actual *impact*—the unemployment, re-

[1] Vide *Scientific Progress*, 1936, p. 186.

direction of skill, and location, and the breaking of sentimental ties that distinguish men from robots. It seems to have not many more expedients for this human problem than our quasi-individualist society with its alleged irresponsibility. It also tends to assume that we can tell in advance what will succeed in public demand and what will be superseded. There is nothing more difficult, and the attempt to judge correctly under the intellectual stimulus of high profits and risk of great losses is at least as likely to succeed as the less personally vital decision on a committee. Would a planning committee, for example, planning a new hotel in 1904, have known any better than capitalist prevision that the fifteen bathrooms then considered adequate for social demand ought really to have been ten times that number if the hotel was not to be considered obsolete thirty years later? Prevision thought of in terms of hindsight is easy, and few scientists have enjoyed the responsibility of making practical decisions as to what the public will want far ahead. They, therefore, tend to think of prevision in terms of knowledge and appreciation of particular scientific possibilities, whereas it involves unknown demand schedules, the unceasing baffling principle of substitution, the inertia of institutions, the crusts of tradition and the queer incalculability of mass mind. Of course, in a world where people go where they are told, when they are told, do what they are instructed to do, accept the reward they are allotted, consume what is provided for them, and what is manifestly so scientifically 'good for them', these difficulties need not arise. The human problem will then be the 'impact of planning'.

It can be conceived that a socialistic organization

of society could obviate such of the maladjustments as depend upon gains and risks of absorption not being in the same hands, and a theoretic technique can be worked out for the most profitable rate of absorption of scientific invention having regard to invested capital, and skill and local interests. It is sufficient to say that it needs a *tour de force* of assumptions to make it function without hopelessly impairing that central feature of economic progress, viz. individual choice by the consumer in the direction of his demands, and an equally exalted view of the perfectibility of social organization and political wisdom. But in the field of international relations and foreign trade, which alone can give full effect to scientific discovery, it demands qualities far beyond anything yet attainable.

I am not here examining the economics of planning as such, but only indicating that it does not provide automatically the secret of correct prevision in scientific innovation. When correct prevision is possible a committee can aim at planning with a minimum disturbance and wastage (and has the advantage over individuals acting competitively), but for such innovation as proves to be necessary it does not obviate the human disturbance or radically change its character. The parts of social life are co-ordinated and some are more capable of quick alteration than others, while all are mutually involved. One may consider the analogy of a railway system which has evolved, partly empirically and partly consciously, as a co-ordinated whole. Suddenly the customary speed is radically changed, and then it may be that all the factors are inappropriate — distance between signals, braking power, radius of curves, camber or super-elevation, angles of crossings, bridge stresses. The harmony

has been destroyed. Especially may this be the case if the new factor applies to some units only, and not to all, when the potential density of traffic may be actually lessened. The analogy for the social system is obvious, and its form of government matters little for the presence of the problem, though it may be important in the handling of it.

I have spoken as though the normal spans of life of men and machinery themselves provide a phase to which scientific advance might be adjusted for a completely smooth social advance. But this would be to ignore customs and institutions, such as we see in Federal America, Australia, and Canada, with constitutions that lengthen that phase and make it less amenable as a natural transition. At one time we relied on these to bring about the economic adjustment necessary. But technical changes take place so rapidly that such forces work far too slowly to make the required adaptation. Habits and customs are too resistant to change in most national societies to bring about radical institutional changes with rapidity, and we patch with new institutions and rules to alleviate the effects rather than remove the causes of maladjustments. The twenty-mile speed limit long outstayed its fitness, and old building restrictions remained to hamper progress. Edison is reported to have said that it takes twenty-five years to get an idea into the American mind. The Webbs have given me a modal period of nineteen years from the time when an idea comes up as a practical proposition from a 'dangerous' left wing, to the date when it is effectively enacted by the moderate or 'safe' progressive party. This period of political gestation may be a function of human psychology or of social structure. We do not know

how ideas from a point of entry infiltrate, permeate, or saturate society, following the analogues of conduction, convection, or lines of magnetic force.

Our attitude of mind is still to regard change as the exceptional, and rest as the normal. This comes from centuries of tradition and experience, which have given us a tradition that each generation will substantially live amid the conditions governing the lives of its fathers, and transmit those conditions to the succeeding generation.[1] As Whitehead says: "We are living in the first period of human history for which this assumption is false". As the time span of important change was considerably longer than that of a single human life, we enjoyed the illusion of fixed conditions. Now the time span is much shorter, and we must learn to experience change ourselves.

We have no adequate technique of change, we treat life as mainly static, with occasional and exceptional periods of change, whereas we must regard it as continuously changing, with occasional and abnormal periods of rest, and we have to secure all the changes of social outlook implied by that reversal of view.

The Duration of Life

The next field in which scientific advance alters the economic problem faster than we can solve it, is in the duration of human life. We have to provide a social dividend adequate to maintain a much larger propor-

[1] "Mankind has declared war against Nature, and we will win. She does not understand yet that her geologic periods won't do any longer, and that while she is pottering along the line of least resistance we are going to travel fast and far until we find her, and then, being a female, she is bound to give in when she is challenged" (James Stephens, *The Crock of Gold*, p. 134).

tion beyond the age to contribute to it. Combined with the altered birth rate, a profound change is taking place in age densities, and the turnover from an increasing to a stationary and then a declining population, in sight in this country, Belgium, Germany, and even the United States, is bound to affect the *tempo* of economic life. A larger and more immediate problem of adjustment is, of course, the absorption of the results of science not in increased masses of new kinds of commodities made by the released labour of labour-saving devices on old kinds, but in generalized leisure. The transition from a state of affairs in which we have an uneconomically high commodity wage paid to a part of the population, and the rest with a mere pittance and enforced idleness, to a state where a part of the reward is taken *all round* in larger leisure, and where economic satisfaction from leisure is deliberately equated to that from commodities in the standard of life, may need a surgical operation, or a catalyst, such as the United States experiment can show.

In the past, the absorption of innovation has been achieved, according to contemporary explanation, by four agencies :

(1) Great elasticity of demand for the old commodities at reduced prices—food and staple household necessities.
(2) Rapid introduction of new things.
(3) The rise in population *created* by the increase in produce.
(4) Overseas outlets in more backward industrial countries.

In the first the elasticity completely alters as the standard arises, and generally there is not now the

scope for lower price in food or clothing increasing the demand *pro tanto*.

The rate of increase in the population has a profound effect upon the total elasticity of demand for these products, and a total purchasing power raised 50 per cent for the same population because it has improved 50 per cent per head, though it may be the same as a total purchasing power at the *same* sum per head for a population half as large again, will be quite different in its effective demand for the elements of life.

For the third, a rising standard no longer stimulates growth of population, but often tends the opposite way. I should like to quote from a book written for the working classes, *The Working Man's Companion, The Results of Machinery*, viz. *Cheap Production and Increased Employment, exhibited*, published by the Society for the Diffusion of Useful Knowledge just over a hundred years ago :

> The multiplication of produce multiplies the consumers of produce. There are probably, upon the average, no more hats made in the year than there are heads to wear them, but as there are fifteen millions of heads of the British subjects of King William IV and there were only five millions of the British subjects of Queen Anne, it is self evident that the hat makers have three times as much work as they had a century and a quarter ago. What has given the hatmakers three times as much work ? The trebling of the population ? And what has trebled the population ? The trebling of produce—the trebling of the means of maintaining that population.

For the fourth, the external outlets are now largely self-producers. As regards the rapid introduction of new things—these mostly now demand increased leisure for their proper absorption and use, so that the two are correlated and mutually dependent.

Cultural Lags in a Dynamic Society

I have so far discussed modification of impact to meet the nature of man. Now we must consider modifying the nature of man to meet impact.

Sociologists refer to our ' cultural lags ' when some of the phases of our social life change more quickly than others and thus get out of gear and cause maladjustments. Not sufficient harm is done to strike the imagination when the change is a slow one, and all the contexts of law, ethics, economic relations, and educational ideals tend towards harmony and co-ordination. We can even tolerate, by our conventions, gaps between them while preachers and publicists can derive certain amusement and profit from pointing out our inconsistencies. But when things are moving very rapidly, these lags become important ; the concepts of theology and ethics, the tradition of the law, all tend to lag seriously behind changes brought about through science, technical affairs, and general economic life. Some hold that part of our present derangement is due to the lack of harmony between these different phases—the law and constitutional or governmental forms clearly lag behind even economic developments as impulsed by scientific discovery. An acute American observer has said that " the causes of the greatest economic evils of to-day are to be found in the recent great multiplication of interferences by Government with the functioning of the markets, under the influence of antiquated doctrines growing out of conditions of far more primitive economic life ". It would be, perhaps, truer to say that we are becoming ' stability conscious ' and, on humanitarian grounds, setting greater store by the evil effects of instability.

In the United States it would be difficult to find, except theoretically in the President, any actual person, or instrument in the constitution, having any responsibility for looking at the picture of the country as a whole, and there is certainly none for making a co-ordinated plan. Indeed, in democracy, it is difficult to conceive it, because the man in public life is under continual pressure of particular groups, and so long as he has his electoral position to consider, he cannot put the general picture of progress in the foreground. Whitehead declared that when an adequate routine, the aim of every social system, is established, intelligence vanishes and the system is maintained by a co-ordination of conditioned reflexes. Specialized training alone is necessary. No one, from President to miner, need understand the system as a whole.

The price of pace is peace. Man must move by stages in which he enjoys for a space a settled idea, and thus there must always be something which is rather delayed in its introduction, and the source of sectional scientific scorn. If every day is 'moving' day, man must live in a constant muddle, and create that very fidget and unrest of mind which is the negation of happiness. Always 'jam to-morrow'—the to-morrow that 'never comes'.[1] A man running a race might be stopped to be given a new magic cordial, which *after* allowing for the two minutes' stoppage, would enable him to finish a minute earlier. But if he is stopped at frequent intervals for other magic

[1] "Civilization means ability to deal with life's accidents as well as with its routine," says Professor J. L. Myres (*The Man of Science and the Science of Man*), illustrating by the failure of the old Pacific life with its lack of reserve of resilient behaviour, or of response to changed conditions by fresh behaviour.

cordials, each advantageous by itself, the total period of stoppages would at some point exceed the possible gains of speed during the short undisturbed running periods, and he would finish later at the post, instead of earlier. This is a parallel to the current effects of too rapid disturbance on progress. If we must have quanta or stages, the question is their optimum length and character, not merely the regulation of industry and innovation to their tempo, but also the education of man and society to pulse in the same rhythmic wave-length or its harmonic.

At this point I ought to state parenthetically that I have never suggested a ' moratorium ' for scientific discovery,[1] although abbreviated press reports of my words have conveyed that impression. Discovery must go on, although we may adjust the forces of attack to particular intensive efforts instead of others. I agree with Professor Myres that historical attempts to check have failed, after disastrous consequences : " The slackening of scientific activity, for whatever cause, is indeed an early symptom of the decay of any culture ; the cessation of it is cultural death".[2] But proper directional emphasis is not excluded.

I do not suggest that certain discoveries should be put into cold storage for 2000 years, like conic sections —that is, deliberately—though it is not unlikely that many things are now worked *out* theoretically in advance of the times, to be worked *into* practical applications far in the future. But I do refer to the possibility of a maximum social advantage in some co-ordination of application which may mean some-

[1] As indicated by Professor Hogben, *The Retreat from Reason*, p. 30, and by Dr. Enid Charles, *The Twilight of Parenthood*, p. 31.

[2] Prof. J. L. Myres, *The Man of Science and the Science of Man*, 1933.

thing less than a maximum or forced application at any particular point. Civilization went through a long period when the limiting factor to progress was the scientific, but is now passing through a stage when the limiting factors are non-scientific. They may be the capacity of minds or materials or societies for the rapidity of change, or for the enormous range of change.

The Balance of Physical and Biological Sciences

In some ways we are so obsessed with the delight and advantage of discovery of new things that we have no proportionate regard for the problems of arrangement and absorption of the things discovered. We are like a contractor who has too many men bringing materials on to the site, and not enough men to erect the buildings with them. In other words, if a wise central direction were properly allocating research workers to the greatest marginal advantage, it would make some important transfers. There is not too much being devoted to research in physics and chemistry, as modifying industry, but there is too much relatively to the research upon the things they affect, in physiology, psychology, economics, sociology. We have not begun to secure an optimum balance. Additional financial resources should be applied more to the biological and human sciences than to the applied physical sciences, or possibly, if resources are limited, a transfer ought to be made from one to the other.

Apart from the superior tone sometimes adopted by 'pure science' towards its own applications, scientific snobbery extends to poor relations. Many of the hard-boiled experimental scientists in the older

and so productive fields look askance at the newer border-line sciences of genetics, eugenics, and human heredity, psychology, education, and sociology, the terrain of so much serious work but also the happy hunting-ground of 'viewy' cranks and faddists. Here the academic soloist is still essential, and he has no great context of concerted work into which to fit his own. But unless progress is made in these fields comparable with that of the golden ages of discovery in physics and chemistry, we are producing progressively more problems for society than we are solving. A committee of population experts has recently found that the expenditure on the natural sciences is some eight to ten times greater than that on social sciences. There is scarcely any money at all available for their programme of research into the immense and vital problems of population in all its qualitative and quantitative bearings. An attack all along the front from politics and education to genetics and human heredity is long overdue.[1] Leisure itself is an almost unexplored field scientifically. For we cannot depend wholly on a hit and miss process of personal adaptation, wide or rapid though this may be.

There must be optimal lines of change which are scientifically determinable. We have seen in a few years that the human or social temperament has a much wider range of tolerance than we had supposed. We can take several popular examples. The reaction to altered speed is prominent. In the *Creevey Papers* it is recorded that the Knowsley party accomplished

[1] "There are actually more trained research workers in chemistry in a single one of the several research laboratories of I.C.I. than there are trained research workers in psychology in the entire country" (Dr. Julian Huxley, *Scientific Research and Some Needs*, p. 264).

23 miles per hour on the railway, and described it as "frightful—impossible to divest yourself of the notion of instant death—it gave me a headache which has not left me yet—some damnable thing must come of it. I am glad to have seen this miracle, but quite satisfied with my first achievement being my last". In the British Association meeting for 1836, an address on railway speeds prophesied that some day 50 miles an hour might be possible. Forty years ago we may remember that a cyclist doing 15–18 miles an hour was a 'scorcher' and a public danger. Twenty-five years ago, 30 miles an hour in motoring was an almost unhealthy and scarcely bearable pace. To-day the fifties and sixties are easily borne, both by passenger and looker-on. Aeroplane speeds are differently judged, but at any rate represent an extension of the tolerance. Direct taxation thirty years ago in relation to its effect on individual effort and action seemed to reach a breaking-point and was regarded as psychologically unbearable at levels which to-day are merely amusing. The copious protection of women's dress then, would have looked upon to-day's rationality as suicidal lunacy.

One hesitates to say, therefore, that resistances to scientific changes will be primarily in the difficulty of mental and physical adjustments. But there can be little doubt that with the right applications of experimental psychology and adjusted education, the mind of man would be still more adaptable. Unfortunately, we do not know whether education as an acquired characteristic is in any degree inheritable, and whether increasing educability of the mass is a mere dream, so that we are committed to a Sisyphean task in each generation. Dr. Alexis Carrel has de-

clared: "We are almost totally ignorant of the genesis of intelligence".[1] Nor do we know whether these aspects are affected by the induced sterility of the age. It may not be a problem of changing the same man in his lifetime, but of making a larger difference between father and son. The latest teachings of geneticists hold out prospects for the future of man which we should like to find within our present grasp,[2] and recent successful experiments with mammals in parthenogenesis and eutelegenesis[3] bear some inscrutable expression which may be either the assurance of new hope for mankind or a devil's grin of decadence.

The New Economics

What is economics doing in this kaleidoscope?

The body of doctrine which was a satisfactory analysis of society twenty-five years ago is no longer adequate, for its basic postulates are being rapidly changed. It confined itself then to the actual world it knew and did not elaborate theoretical systems on different bases which might never exist. It is, therefore, now engaged in profoundly modifying the old structures to meet these new conditions. Formerly it assumed, quite properly, a considerable degree of fluid or competitive adjustment in the response of factors of production to the stimulus or operation of price, which was really a theory of value-equilibrium. Wherever equilibrium was disturbed, the disturbance released forces tending to restore it. To-day many of the factors formerly free are relatively fixed, such as wage

[1] *Man, the Unknown.*

[2] Vide C. C. Hurst, *Mechanism of Creative Evolution*, chap. xx.

[3] Vide *Eugenics Review*, 1935, p. 121, by H. Brewer.

levels, prices, market quotas, and when an external impact at some point strikes the organism, instead of the effect being absorbed throughout the system by adjustments of all the parts, it now finds the shock evaded or transmitted by many of them, leaving the effects to be felt most severely at the few remaining points of free movement or accommodation. Unemployment is one of these. The extent to which this fact throws a breaking strain upon those remaining free points is not completely analysed, and the new economics of imperfect competition is not fully written out or absorbed. The delicate mechanism of price adjustment with the so-called law of supply and demand governed the whole movement, but, with forcible fixation of certain price elements, consequences arise in unexpected and remote quarters. Moreover, the search for a communally planned system to secure freedom from maladjustments involves a new economics in which the central test of price must be superseded by a statistical mechanism and a calculus of costs which has not yet been satisfactorily worked out for a community retaining *some* freedom of individual action and choice.

The old international currency equilibrated world forces and worked its way into internal conditions in order to do so. But the modern attempt to prevent any internal effect of changes in international trade, or to counteract them, and the choice of internal price stability at all costs against variable international economic equations, has set economic science a new structure to build out of old materials. At this moment when elasticity is most wanted, stability leading to rigidity becomes a fetish. The aftermath of war is the impossibility of organizing society for peace.

The impact of economic science upon society to-day is intense and confusing, because, addressing itself to the logic of various sets of conditions as the likely or necessary ones according to its exponents' predilections, it speaks with several voices, and the public are bewildered. Unlike their claims upon physics and mathematics, since it is dealing with money, wages, and employment, the things of every day, they have a natural feeling that it ought to be easily understandable and its truth recognizable. Lord Balfour once said, in reference to Kant, "Most people prefer the existence of a problem which they cannot explain, to an explanation of it which they cannot understand".[1] But in the past twenty years, the business world and the public have become economics-conscious, and dabble daily in index numbers of all kinds, and the paraphernalia of foreign exchange and statistics of economic life. The relativity of economic principle to national psychology baffles the economists themselves, for it can be said truly at one and the same time, for example, that confidence will be best secured by balancing the Budget, and by not balancing it, according to public mentality.

The economics of a community not economically self-conscious are quite different from those of a people who watch every sign and act accordingly. Thus the common notion that economics should be judged by its ability to forecast (especially to a particular date) is quite fallacious, for the prophecy, if 'true' and believed, must destroy itself, inasmuch as the economic conduct involved in the forecast is different after the forecast from what it would have been before. The paradox is just here, for example: if a people are

[1] Vide General Chas. Dawes, *Notes as Vice-President*, p. 113.

told that the peak of prices in a commodity will actually be on June 10, they will all so act that they anticipate the date and destroy it. Economics, thoroughly comprehended, can well foretell the effects of a tendency, but scarcely ever the precise date or amount of critical events in those effects. The necessity for a concentration upon new theoretical and analytical analysis, and upon realistic research, is very great. But so also is the need for widespread and popular teaching. For a single chemist or engineer may by his discovery affect the lives of millions who enter into it but do not understand it, whereas a conception in economic life, however brilliant, generally requires the conformity of the understanding and wills of a great number before it can be effective.

"Economists generally fail to notice that 'human interference' is a part of the 'natural course of events'. This natural course of events is not to be conceived mechanically; for the social process is changed by every improvement in our understanding of that process. Herein, of course, lies the worst of the difficulties of the social scientists." [1]

There are some important interdependencies between economics and eugenics which will be discussed in the next chapter.

Economic life must pay a heavy price, in this generation, for the ultimate gains of science, unless all classes become economically and socially minded, and large infusions of social direction and internationalism are carefully introduced. This does not mean government by scientific technique, technocracy, or any other *transferred* technique, appropriate as these may be to the physical task of production. For

[1] V. W. Bladen, 'The Trend of Economics' (*Dalhousie Review*).

human wills in the aggregate are behind distribution and consumption, and they can never be regulated by the principles which are so potent in mathematics, chemistry, physics, or even biology. . . .

In all sections men are dealing with things that ' stay put ' while they study them, that act to-morrow as they act to-day, that act in New York as they act here—real reliable constants, vitamins, chromosomes, hormones, Planck's constants, electrons, flavines, carotenes, proteins, and limestones. They have to learn to deal with wills, prejudices, races, religions, fads, fancies, motives, and delusions. A great draft on the highest mental ability for such social studies is essential. In so doing, they will get a new range of marginal satisfactions in life, a new sense of solidarity and the moral implications of science and discovery. The moralists too will learn their lesson—in Canon Streeter's great words, " Science is the great cleanser—it renders possible no religion but the highest ".

The Science of Man

But not alone economics : if the impact of science brings certain evils, they can only be cured by more science as well as better or different politics and government. Ordered knowledge and principles are wanted at every point. Let us glance at three only, in widely different fields : man's work, man's health, man's moral responsibility. The initial impact of new science is in the factory itself. The kind of remedy required here is covered by the work of the National Institute of Industrial Psychology. Some of this improves upon past conditions, some creates the conditions of greater production, but much of it combats

the evils arising from new conditions created by modern demands, speed, accuracy, and intensity. It invokes the aid of many branches of science. It is the very first point of impact. Yet its finance is left to personal advocacy, and commands not 10 per cent of the expenditure on research in artificial silk, without which the world was reasonably happy for some centuries. We can judge of the scope of this by the reports of the Industrial Health Research Board.

Again, the scientific ancillaries of medicine have made immense strides. Clinical medicine as an art makes tardy, unscientific, and halting use of them. The public remain as credulous as ever, their range of gullibility widened with every pseudo-scientific approach. (We do not know what proportion of positive cases can create the illusion of a significant majority in mass psychology, but I suspect that it is often as low as 20 per cent.) For a considerable range of troubles inadequately represented in hospitals, the real experience passes through the hands of thousands of practitioners, each with too small a sample to be statistically significant, and is, therefore, wasted from a scientific point of view. Half-verified theories run riot as medical fashions, to peter out gradually in disillusionment.[1] If the scattered cases were all centralized through appropriately drawn case-histories, framed by a more scientifically trained profession, individual idiosyncrasy would cancel out, and mass scrutiny would bring the theories to a critical statistical issue of verification or refutation in a few months. Cures would no longer be as epidemic as diseases.

[1] Prof. Mottram instances especially the treatment of so-called intestinal toxaemia by cultures of *Bacillus bulgarious* and by surgical removal of the large bowel (*The Frustration of Science*, p. 93).

This would be to the advantage of all society, and achieve an even greater boon in suggesting new points for central research.

A suggestion has been made for an inventions clearing-house, to " co-operate the scientific, social, and industrial phases of Invention, and to reduce the lag between invention and application " managed by a committee of scientists and a committee of industrialists and bankers. The proposal came to me from New York, but London was to be the home of the organization, which was to adopt a code of ethics in the interests of inventors, industry, and *social progress*. This brings me to my third example, the field of ethics, which needs the toil of new thought. The systems of to-day, evolving over two thousand years, are rooted in individualism and the relations between individuals. But the relations of society to-day are not predominantly individual, for it is permeated through and through with corporate relations of every kind. Each of these works over some delegated area of the individual's choice of action, and evolves a separate code for the appropriate relationship. The assumption that ethical questions are decided by processes which engage the individual's whole ethical personality is no longer even remotely true. The joint stock company may do something, or refrain from doing something, on behalf of its shareholders, which is a limited field of ethics, and may but faintly resemble what they would individually do with all other considerations added to their financial interests. The whole body of ethics needs to be reworked in the light of modern corporate relations, from Church and company to cadet corps and the League of Nations.[1]

[1] Vide my recent work, *Motive and Method in a Christian Order*.

In no case need we glorify change: but true rest may be only ideally controlled motion. The modern poet says:

> The endless cycle of idea and action,
> Endless invention, endless experiment,
> Brings knowledge of motion, but not of stillness.

But so long as we are to have change—and it seems inevitable—let us master it. T. S. Eliot goes on:

> Where is the wisdom we have lost in knowledge?
> Where is the knowledge we have lost in information?

Many writers have dealt with the shortcomings of the active world—to me they are but the fallings short of science. Wherever we look we discover that if we are to avoid trouble we must take trouble—scientific trouble. The duality which puts science and man's other activity in contrasted categories with disharmony to be resolved, gaps to be bridged, is unreal. We are simply beholding ever-extending science too rough round the edges as it grows.

What we have learnt concerning the proper impact of science upon society in the past century is trifling, compared with what we have yet to discover and apply. We have spent much and long upon the science of matter, and the greater our success the greater must be our failure, unless we turn also at long last to an equal advance in the science of man.

CHAPTER II

EUGENIC INFLUENCES IN ECONOMICS *

The control and direction of the numbers of the people, with eugenic and economic ideals, is the background of the science of social adjustment.

THE stress laid upon the influence of population in the last chapter leads to further fields of study in which economics and eugenics merge. It is true that little can be done eugenically to meet any present difficulty, but it is desirable to see clearly the economic implications of eugenic aims for the future, and since the economic is so considerable a part of the total social welfare, perhaps to modify those aims accordingly. Numbers of population have an influence upon demand and its satisfaction—this in return may locally affect quality and numbers too.

Careful examination of the aims and scope of eugenics convinces me that they all must issue in effects upon the size of population, *i.e.* its total numbers, its distribution, and its stability. Put negatively, I cannot find that any eugenic aims, effectively secured, will leave the numbers and dynamic quality of population unaffected, and influence merely its moral or social structure, its standard of life, or its individual

* The Galton Lecture, delivered before the Eugenics Society on February 16, 1934, amplified and revised.

happiness. A society having, unitedly or individually, eugenic aims will ultimately almost certainly result in total numbers different from what would result if, collectively or individually, it had no eugenic knowledge or objectives. Even if one realized the mathematically almost impossible and the two totals were identical at some *point* of time, they would almost certainly diverge in the *course* of time. It is not necessary to make any Malthusian assumptions about an unchecked tendency to multiply to the limits of subsistence in this argument.

The aims of eugenics, while no doubt having *quantitative* effects, are actually directed at qualitative improvements — a smaller proportion of defective individuals and a larger of competent ones; what is loosely called negative eugenics being aimed by common acceptance at the former, and positive eugenics, less commonly received, at the latter. But it nowhere appears whether it is an aim to balance the repression of every birth below the modal line by the gain of an extra birth above it, so that the numbers of the population remain unchanged, and I should imagine that no eugenist has any programme so precisely quantitative.

But we aim at eliminating anti-social elements, and so a higher average quality of the race for social action to the common advantage must follow, with immensely potent results. The aim that stands in the forefront is, of course, the improvement of the individual himself, to live and lead *the good life*, and the changes in the distribution of the population in quality are an inevitable corollary.

But suppose that the population has been brought by eugenic methods to an ideal state for potentially enjoying the good life, it may be that the methods

would then actually prevent that enjoyment, if they were so inhibitory, so drastic, so contrary to ideas of liberty, that life is hardly worth living. Eugenics would then be like the mother taking her blubbering small boy out: "I brought yer here to enjoy yerself, and enjoy yerself yer shall, if I break every bone in yer body!" If the only conditions on which the position of perfect enjoyment can be attained are those which prevent its being enjoyed when it *is* reached, if we must go on enduring them, then the population and distribution we secure will be unstable and not durable. I distinguish sharply between reaching a state and establishing a process.

If we could quantify the individual *physical* fitness of the population, I imagine it would give the normal curve of error, with a very large mode of average quality and relatively small numbers on either side of exceptional fitness and unfitness. But quantifying individual *mental* capacity (above the deficiency level) would I think give a different distribution, despite the brain-capacity normal curves given by such observers as Dr. H. L. Gordon, writing on 'Amentia in the East African'.[1] Like the empirical Pareto law for the distribution of wealth, I believe it would be found to be along a diagonal line practically straight, except for the two extreme ends, when plotted against a vertical axis representing degree of mental capacity, and a horizontal axis for the numbers exhibiting that degree or more, both axes being expressed logarithmically. Now the slant of this line would be of immense eugenic significance. If great intelligence were in rather high proportion, and small intelligence relatively low, the straight line would tend to be more upright. If

[1] *Eugenics Review*, vol. xxv., January 1934, p. 223.

great intelligences were few and small intelligences were more numerous, the line would slant more severely, *i.e.* have a more acute angle with the base. If birth control knowledge and habits are confined to the professional, educated, and most able classes the effect is dysgenic, and the distribution line gets more acute. If it eats away at the mass of lower intelligence, it tends to be eugenic, and the distribution line becomes more upright. If it applies equally through all classes of the population, the index, or slant of the line, may be restored to its original degree, but, the total population being then so much less, it must lie strictly parallel to the first, in a position considerably to the left. I am not sure, then, that contraceptive practice can be called strictly eugenic at all, for eugenics has had so little to say upon the absolute numbers of the population. So long as birth control is being advocated in certain classes to compensate the dysgenic influence elsewhere, or so long as it applies solely to the less developed intelligence, it is eugenic, and as that is the predominant case at the present time, birth control tends to rank as a eugenic aim. The day may easily come when it will not be so readily accepted.

Eugenics and Total Numbers

The truth is that the main body of eugenic teaching has not yet crystallized around any specific doctrine of population. Birth control, in certain circumstances, birth encouragement in others, and a continually improving social environment which, however kind to the individual during his life, will not unduly endow the weaker, from an heredity point of view, nor burden the stronger from the point of view of spoiling his

environment or affecting his heredity: all these doctrines lead to a continually improving quality, but they prescribe nothing as to total numbers. Total numbers must be what they will be, as a result of this process.

Does eugenics demand a continually increasing total, or a stationary or a falling population? I imagine that if there is a continual upward shift qualitatively in its component parts, any one of these will satisfy eugenic aims, although there is an implied preference for the increasing total if it is equally compassable without giving anything of this qualitative change away. But if the eugenists were presented with an alternative between a rising total with a moderate upward qualitative shift, and a stationary or slightly falling total with a very great upward shift in quality, they might differ among themselves as to the true choice. They would almost inevitably be driven to apply some such tests as are involved in the economic concept of the optimum population.

Sargant Florence declares that what really distinguishes the economist from the eugenist is his concentration upon quantity rather than quality of population. His marginal man is not one who is inferior in industrial capacity, but any one of a group of given size. It is the given size that matters.[1] Dr. Julian Huxley shows clearly that the eugenic ideal will vary with the concept of the State. The eugenist "must adopt different aims according as to whether he envisages a world of nationalism and war, or one of peace and cultural progress".[2] Dr. Enid Charles

[1] *Eugenics Review*, vol. xix., April 1927, p. 66.

[2] 'Eugenics and Society', *Eugenics Review*, 1936, p. 23, etc.

considers that biological necessity will *determine* the duration of a *laisser-faire* economy.[1]

In economics we conceive at any particular point of time, and for a particular area, a population large enough, when applied to the natural resources of that area, to get a total production which, when divided by the numbers of the population, gives a maximum quotient or standard of life. Every additional person taken into an under-developed area can increase that average, but every additional person in an over-developed area lessens it. The economic optimum is the maximum average. Now, obviously, this is not necessarily stable. The natural resources may be increased, or new ones discovered, by science, the resultant birth-rate may move the population higher or lower than this optimum number. Moreover, the resultant density of population and average income will vary greatly in the different areas. Free trade may increase the quotient for some much more than for others, and the increase in standard may be purchased at the cost of great instability in the standard. A particular area may choose a lower optimum point, with less risk of disturbance from outside forces. This is aimed at in the most respectable types of economic nationalism.

I am by no means sure that the eugenic optimum is the same. The eugenist will probably say that he is not bigoted about the absolute size of the population. In so far as life is a good thing and full of opportunity for self-realization, not necessarily by excessive leisure leaning to over-indulgence, but biologically stable, then let there be as many people as possible to enjoy that good life. But when numbers become so great as

[1] *The Twilight of Parenthood*, p. 35.

to endanger the social or national conditions of this life, then possibly the eugenic optimum is passed. We can conceive a community with the ideal density and concentration for adequate and happy government, becoming, without loss of economic well-being, by increase of population, too cumbrous for the methods and organization in force. Taking an analogy, consider a succession of cars along a highway, the occupants perfectly happy and free from care and well provided with provisions. Now multiply the number a hundredfold, each car's occupants just as well provided as before with good things, but the congestion and discomfort of the traffic rendering the journey unhappy and anxious. As material economic progress frees our leisure and attention for the other values of life, the conception of a good life will contain more and more of those values in proportion, and an optimum population from an economic point of view is less and less likely to coincide with the optimum population from the other points of view. Something also depends upon whether the 'other points of view' include an exercisable right to all kinds of satisfaction, on the principle of equality. If the solitude of Cheddar Gorge or Glencoe and its inspiration is a higher type of 'good', and we presuppose that everyone should have the right to enjoy it, it is destroyed *ipso facto* by the millions. I am reminded of a railway advertisement: "Do you dislike crowds? If so, come to X."

Again, in the absence of complete free trade, and free movement of surplus populations to the areas relatively most eligible, those parts of the world with the best developed natural resources will have a higher density of optimum population, or, at any rate, a higher standard for their optimum density than the

less favoured portions. If the eugenic aim of the highest good life is identical with the economic optimum in sections, it would have to vary with the abolition of national boundaries, it would have to postulate wide variations in its own ideal, and the anomaly would not be removed until the population of the world were looked at as a whole, with an identical standard of life.

It is possible to view the ideal in another way, that of a population in numbers and quality ideally fitted to the physical and intellectual demands of a smooth-working society, without waste of ability or shortage of it. A good population requires a supreme leader, a number of high administrators, a certain quota of professional men (in medicine, etc.), an appropriate number of machinery experts, of industrial leaders, of educationists, of scavengers and cleaners and manual workers. If there are a thousand Mussolinis there is waste; if not enough intelligences for certain grades, there is ineffective adjustment, and if too many of the lower range, excessive population, judged by fitness of means to ends. It may be the eugenic aim to produce a highly differentiated and yet integrated organism, rightly adjusted in its parts, so that each is of maximum service to the whole, and no part has unused or unoccupied ability, and no function is under-manned. Dr. Dublin says: "Experiments are being made to demonstrate that the most effective society is that in which every man is a significant unit—an end in himself—irrespective of class, station, or tradition. If this aim is realized, the individual will come into his own. Under such conditions, if the people of Russia, India, and China continue to people the earth, they will in all probability

dominate it also." Sismondi said: "Statesmen should endeavour to find the relation between wealth and population which shall ensure the greatest sum of *happiness* to the human race". A. Landry[1] defines a maximum population really in terms of saturation, when increase in births entails a larger increase in deaths. This is virtually now an unrealistic conception. His idea of an optimum population is economic, because it depends upon a standard of living and not of culture.

Professor Pearl's suggestion that eugenics preaches the freedom of birth as restricted to superior people only, has been indignantly repudiated: "The mediocre are obviously as necessary for the world's work as the superior. A too great increase in the supply of the latter might indeed result in a lack of employment worthy of their capacity; but on the other hand, any absolute decrease in their number would be a real calamity."[2]

In proportion as getting a living tends, under progress, to become more and more a subordinate part of total life, I do not regard it as calamitous that intellectually a great many people may be better than their jobs. The gillie in Barrie's *Mary Rose* was none the less living the good life because he kept Euripides in his pocket, the while his well-born employer didn't realize that he 'knew Latin'. If the intellectual and emotional life is fully extended in leisure, the best brains may, without deterioration, be engaged upon relatively minor and unexhausting duties.

German writers have expressed the view that we insist too much on the value of contraceptive ideas in the sections having the lower wage-earning capacity,

[1] *Scientia*, xlv. [2] *Eugenics Review.*

bringing about a reduction of numbers and racial improvement. They prefer a different angle—a certain population density is the necessary biological foundation of any sort of culture, and this " density is severely threatened by the fall in the birth-rate, so that they cannot obtain a qualitative race improvement by quantitative reduction in population ".

But these close adjustments are idealisms, and in the meantime the economic is still so dominant a factor that the optimum population in each present given area, regardless of the variations, may be taken as probably the unconscious eugenic aim for that area.

It is latent in Colonel Sir Charles Close's conclusion to his lecture on " The Situation in South and East Asia ": " Should a philosopher statesman prefer an India of 350 millions of shortlived, underfed, uncultured people, or an India of half that number, but fitter in mind and body, with greater opportunities for self-development and expression ? " [1]

The Economic Optimum Population

That being so, we ought perhaps to stay for a while and examine more closely the economic doctrine. This concept lines up to-day from beginnings with Malthus. He thought of two absolute quantitative series coming into conflict—absolute numbers of people and absolute quantities of food, with a limiting factor rather than a causal nexus. That an increase of general prosperity should be the *result* of an increase in population did not enter his head—his concept was agricultural. John Stuart Mill and others strengthened the argument by bringing in the law of diminishing returns

[1] *Population*, vol. i. No. 1, June 1933, p. 67.

for agriculture. Ricardians had not distinguished the time element—what may be true for instantaneous variation at any point of time may not be true for a gradual change over a period. "From the fact that if at any time the population exceeds a certain definite size the additional work it is able to do will not be commensurately productive, they quite illegitimately inferred that as population actually grows, so the return to its efforts must diminish. They elevated, that is to say, what is properly a law of static economics, into a law of dynamic or historical development." [1]

In the preceding chapter [2] I gave an illustration of the defence given against the charge that machinery created unemployment. Preceding that quotation, the question ran: "Inasmuch as the steam engines increase the productions by which men are maintained, they increase the men. What has increased the population of England nearly tenfold during the last five hundred years, but the improvements of the arts of life, which has enabled more men to live within the land? . . ."

J. S. Mill, to some extent, combined the concepts: "Improvements counteract the law of Diminishing Returns, but they do not make increased numbers any less undesirable". Mill's optimum was a stationary fixed one, whereas the modern concept is of an optimum always shifting. Mill thought that if the population had not increased so much with the improvements, there would have been a larger *per capita* quotient. The late Victorian economists got slowly away from this, and Robbins thinks Sidgwick was the genuine forerunner of Cannan, in bringing out the true

[1] L. Robbins, 'The Optimum Theory of Population', *London Essays*, p. 107.

[2] Page 56.

implications of the optimum in 1888. By 1903 he stated the principle of maximum production "constantly shifting, generally in the direction of increasing the population which is consistent with the maximum productiveness possible at the time". Later 'maximum return' was the expression used. Robbins says that Wicksell first used the term 'optimum population'.

Some developments of the concept may be briefly noted, since they are of high significance when determining the relation between a eugenic and an economic optimum.

(1) Pressure on subsistence is not a determinant. On the modern theory an area is over-populated when total returns per head are less than they would be if the population were a little smaller, and this is a point which may be reached long before there is any question of such pressure. Theoretically, a community with a millionaire standard might be over-populated in an economic sense, if the elimination of one millionaire increased the per head return to the rest.

(2) The wages fund or lump of labour theories are much affected—less labour may not mean a rise in wages.

(3) "It may quite well be that a population which was at the optimal point with a certain amount of property distributed in one way would be either too small or too large with same amount distributed in another way." The changes in numbers may mean a change in the form of organization.

(4) Professor Robbins points out the fallacy of supposing that a steady increase of average real income per head (as in England in the nineteenth century) is evidence that there was no over-population.

It may have been below the point of maximum return *throughout* because of over-population, but less so at one point than another; or it may have been unequally distant from the changed optimal point. "Over-population may be present long before real *incomes* begin to go down."

(5) Particular inventions may shift the optimum one way *or* the other.

(6) A community cannot have an optimal point independent of all others. "An agricultural invention in the Antipodes, a stable government in a Central American State . . . may affect the point of maximum return for the most parochial central European statelet."

(7) A distinction has been made between absolute over-population and relative over-population when a unit of labour is less productive than elsewhere. Nationalism is often a struggle to prevent any equalizing tendencies where differentials exist.

(8) It may be necessary to give a commodity equivalence to leisure in order to weight it in with physical satisfactions in an economic total, or otherwise comparison between two optimal points may be meaningless.

All these concepts are impossible to quantify, in the present state of our statistical knowledge, and the very rapid flux in which we live. But they serve to show us some of the issues involved in making the economic and eugenic optimal points coincide. Recent opinion is that, while the optimum theory has had historical value in diverting attention from the starvation limit, and while it may still provide a stimulus towards the interesting work of investigating the relations between numbers and material wealth, it is

not yet really entitled to a place in the corpus of theoretical economics.[1]

The Coming of a Stationary Population

We have already referred to the population tendencies.

There are three rapidly changing factors: first, total size of population; second, differential birth-rates, and the quality and density of those populations; and third, natural and scientific resources. We are now in sight of the time when one of these three will become relatively stable in several large countries. In Britain the maximum population of between 48 and 49 millions is due shortly and it remains practically stationary for many years—the disproportion between the sexes will diminish, the age distribution will give a shift upwards, so that the oldest classes will be in a higher proportion as shown on p. 39. (Bowley's results quoted by Carr Saunders: *Encyclopaedia Britannica.*) In America the maximum comes a little later, between 1960 and 1970, at 148 millions, sinking to 140 by the year 2000. The proportion of persons 50 years old and upwards will be 35½ per cent against 23 in 1950 and 15 in 1920, and America will be a population of old people instead of youthful as it is now.[2] Belgium's maximum comes in 1940 at 8,110,000 and gets to 6,725,000 by 1980 according to Professor Baudheim.[3] Germany, contrary to most views, is also on the same road. It has been computed that her maximum is reached about 1940 at 65½ millions, and

[1] Vide Lindley M. Fraser in *Population*, vol. i. No. 2, p. 37.

[2] L. Dublin, 'Outlook for the American Birth Rate', *Problems of Population.*

[3] *Ibid.* p. 247: 'Future of the Population of Belgium'.

one authority [1] roughly estimates a rapid decline to 59 millions by 1960 and 49½ millions by 1975. He gives the economic consequences as increasing real wages and a rising standard of life, culture expenditure increasing considerably, with agriculture and building depressed.

Now this represents a phase, not indeed new in all history, but new in such a stretch of modern experience as is covered by scientific and industrial progress and conscious social direction.

What is the attitude of the eugenist towards a stationary population? Is it possible to raise that population steadily in average value, or is it better to aim at some continued upward movement because of ultimate general gains on the economic side, at the sacrifice of average quality? It is probable that by then the problem of defectives as dynamic dysgenic agents will have been largely solved and the tasks of negative eugenics mainly achieved. Shall we have made enough advance in the knowledge of human genetics to formulate a positive programme?

The economics of a stationary population will certainly present some important differences from those of populations that have been growing steadily for a long period of years, and where the economic structure and habits have accommodated themselves to progressive increase. This is not the place to develop that theme in any detail, but one or two broad indications may be given. First, let us assume that with increasing capital wealth the unit dividend of the stationary population continues to rise. A total purchasing power may double because a stationary number of people have twice the average income, or because

[1] Ernst Kahn, *Der internationale Geburtenstreck.*

double the number of people have the same average income. The direction and intensity of the purchasing power, and its effect upon supplies of different kinds, will be profoundly different in the two cases. Where two people are demanding instead of one, they naturally duplicate demands over a considerable range of essential products. Where one person has a double income his elasticity of demand for the first essentials changes rapidly, and his additional demand passes into a totally different range of commodities. I anticipate a profound change in this respect within the next thirty or forty years.

In the second place, the whole *tempo* of progress, particularly for the introduction of new things, is altered, and the supply of those products for widely expanding markets, dependent upon increasing population, may be completely changed. Within a *zone* of time from any particular *point* of time, it may be said that the purchasing power is a fixed quantity and demand for every new attraction is a subtraction from the demand for some prior one.

Third, apart altogether from the outlook for innovation in a marketing sense, there will be quite a different degree of adjustability, without human suffering, to innovations successfully received. We have already seen that when there was a constantly expanding market through an increasing number of new mouths and new bodies, there was a capacity for adjustment to an altered stream of supply, which introduced a very elastic element into society. But now that so many civilized countries are heading for a stationary population, this safety-valve no longer exists, and the full force of every change in demand, through innovation, is expressed in an alteration in the demand of a

certain fraction of the population and a corresponding immediate derangement of a certain fraction of supply. The suit that is no longer wanted by Jim cannot be passed on to his younger brother, Bill ; Elsie's frock is no longer cut down for Mary Ann, and the alteration this introduces into the *tempo* of economic change is far-reaching and makes the modern problem all the more difficult. Change is more rapid and the capacity to meet it more restricted. We have seen that with a stationary population, an innovation that reduces an existing demand by, say, x per cent of workers puts that percentage out of work until they can learn new jobs, move their homes, and perhaps even change their nationality and become citizens of other countries.

It is interesting to record the conclusions of one or two of the writers upon the economic effects of present tendencies. Professor Warnring, University of Copenhagen, gives as the economic effects of birth control in Denmark : [1]

(1) Progress of all kinds will become slower.
(2) The rate of interest will become lower ; the supply of capital will be greater, and the demand smaller.
(3) The land rent will not increase.
(4) A smaller proportion of the population will be engaged in the trades, producing capital goods.
(5) When we install plant, build factories, schools, etc., we should be very careful not to build them on too great a scale, or they will tend not to be used to full capacity.
(6) Adjustment to new structural conditions will be more difficult and expensive when relative

[1] *Trends in Agricultural Production in Denmark.*

decrease for a certain trade also means absolute decrease.

(7) But the periodic depressions will be milder when the towns do not grow, their growth cannot be discontinuous.

(8) Migrations will be fewer.

(9) A greater proportion of the population will be in the older age-groups, supported by old-age pensions.

Generally, conditions will become so altered that we older economists and statisticians, familiar with constant conditions in the growth of population, will have much difficulty in understanding the new age.

Again, as regards the United States, P. K. Whelpton has depicted the situation, now unescapable, in the near future: population increasing at a slower and slower rate up to an estimated maximum of 144·6 millions in 1970 and declining thereafter.

The age group 20–49, which includes the best period for physical work, will show little relative change, amounting to about 43 per cent of the estimated 1980 population as it now does. The group 50–69 will amount to about 24 per cent in 1980 against 13·9 per cent in 1930, and those 70 or over nearly 7 per cent instead of 3·1 per cent. It will be as though one-third of the children and adolescents of to-day were transformed overnight into men and women all past middle age—some in their dotage. The effects, he says, are that it will be hard on extreme optimists and boosters. The idea of rapid population growth being the normal thing is so firmly engrained that it will be a shock. I, personally, should liken it socially to treading on the top step of the stairs that isn't there. He

goes on to say that the spirit of optimism engendered by our rapid and continuous population growth has been suggested as partially responsible for the efficiency of their industrial development. If this disappears, it may lead to great caution in many ways. For example, there may be less readiness to allot funds to install up-to-the-minute equipment in place of highly serviceable but slightly obsolete methods. It is likely to make competition increasingly keen in industry and commerce. He refers to the additions now being planned to production units which will not be justified, and sees the proper outlet, an increase of the purchasing power of the bulk of the population through a more even distribution of income, a goal which seems difficult to reach in the present capitalistic structure. There will be increased U.S.A. competition in the export trade. But there will be offsets such as educational facilities at last catching up, and less necessity for Treasury grants for paving, and building sewers, so that there will be more available for beautifying cities and providing amenities. The changes in age composition will make for greater conservatism, the continuation of older men in positions of control and a check on the rapid rise of youngsters. If older workers are kept profitably employed in future, the change in age composition may work to increase economic prosperity. The ageing will have a marked effect on the consumption of various products and possibly on the system of taxation.

The spread of a 'controlled' birth-rate is a more significant fact for the future of society than any discovery of physical science or other solvents of the old social order—at present national but soon international. In order to moderate the argument, I

have been referring to 'stationary' populations, whereas what we are really facing are diminishing ones, and all that has been said errs on the side of caution accordingly. Dr. Enid Charles declares that industrialism is already a biological failure.[1]

The Demands of Stationary Populations on Eugenics

Whatever may be the economic situation and the tendencies for stationary populations, it is probable that it will make even greater demands than in the past upon leadership, organization, power of co-operation, socially and internationally. That beautiful momentum that has come about by processes I have described, due to increases in population, being no longer available, if civilization is to prevail, its component parts must be of finer material. Here, then, come in the ideals of eugenics. The necessary components are:

(1) The elements of genius.
(2) An adequate contribution of mass and specialized talent.
(3) Higher intellectual and moral qualities in the mass of the people, and ability to make use of a growing complex social heritage without being dangerously and vulnerably parasitic upon it.

The facts for 1940–50 are unalterably before us at a short distance of time. Eugenic changes can operate only slowly. It seems to me, therefore, that any formulation of a eugenic programme must be suited

[1] *Op. cit.* p. 105.

to the new outlook and to the economic probabilities of stationary and ageing populations, and is already belated and ought to be vigorously pursued. Let us sketch briefly under these three heads the immediate position of eugenic thought.

Genius and Insanity

There is a strong—almost incurable—popular sentiment that genius is akin to madness, not only in character and habit of life, but also genetically, and that it is a pretty close thing whether a person goes over the border of general sanity or remains on the right side of it with abnormal powers. Two hundred years ago Dryden wrote :

> Great wits are sure to madness near allied,
> And thin partitions do their bounds divide.

The suggestion is that if, through eugenic aims, we had no epileptic, neurotic, or otherwise abnormal people, we might get no Keats, Shelleys, Popes, and other geniuses. In this sense, it is urged, the birth of a great number of doubtful lives is the price we pay for an occasional genius, and if we cut off the supply of the one we risk getting none of the others. There are no doubt problems of definition, and the aim of positive eugenics might be achieved by the constant increase in the number of talented people and an improvement in their talent, but it might be quite unable to control or encourage the production of that subtle quality we call ' genius '.

For the purpose of further analysis, let us assume this to be true. From an economic point of view how important is it ? Genius in music, poetry, art, litera-

ture, however important, has no immediate bearing on improvement in the economic standard, but genius in science and engineering and government certainly has. A Newton, Faraday, or Mussolini makes a profound difference in this field. It is, however, still open to question whether more is not going to come as the result of a mass attack of high talent, all along the front, than of individual genius in the future, and if we had a certain alternative between a eugenic system which guaranteed the increase of advanced talent on a wide scale, or the possibility of an occasional genius, we might well, in the economic field, choose the former.

This popular view received a great stimulus by that arresting play, *A Sleeping Clergyman*. In the third (or more) generation of abnormality, the eccentric Dr. Cameron, whose genius saves the country and gets him world honour, is the standing type for this argument. His guardian declares: "Laddie, you're the son of a bad man and a foolish girl—and it gets worse as it goes back. If I'd been one of those eugenic madmen, I'd have drowned you when you were a pup." Cameron declares heredity to be rot. "You say I'm a mixture of blackguards and idiots; well, you'll have to let the mixture be and hope for the best." Dr. Marshall rejoins: "But there is genius in the mixture, too, Charlie, we mustn't let that . . ." Cameron: "Let it be then; what sort of a man are you to bring genius to heel and teach it dog's tricks!"

Even if it were true that an occasional genius seems to be the reward for suffering a great mass of defectives, we certainly can state that not all genius has been so evolved, and there is no evidence that we cut off the whole supply, or possibility of supply, of genius by the elimination of defectives.

Eugenists do not generally admit any association of this kind between genius and mental deficiency. Professor Ruggles Gates speaks very positively: "The loss of a whole feeble-minded stock would not involve the suppression of a single genius. No record exists of the birth of a genius among the offspring of feeble-minded parents."[1] In his Galton lecture several years ago, Dr. Tredgold asserted roundly that there is no correlation between genius and insanity.[2]

The Burden of Defectives

It may be that if eugenics could produce one genius that would otherwise never have been born, it would do more for economic standards than shutting the door of birth upon a potential ten thousand mental defectives.

What is the actual economic burden of defectives? They represent a certain proportion of the population as a burden upon the rest, for food and clothing and perhaps social services, such as specialized education, taking from the general 'heap' of production without adding to it any essential items for the general standard of life.[3] In this they are akin to an addition to a standing army, except so far as the presence of an army is an essential feature in allowing the general heap of production to be piled up in security, and to be larger than it might otherwise be in an unprotected state. But he would be a bold man who asserted that the additional production due to this cause is greatly in excess of the unseen subtraction from pro-

[1] *Heredity in Man*, London, 1929.
[2] *Eugenics Review*, vol. xix., April 1927, p. 1.
[3] Vide my *Wealth and Taxable Capacity*.

duction, due to the withdrawal of the soldiers from the productive field. I may take, as a parallel, any class kept in idleness, through unearned income drawn from the general production. In this case, however, the existence of such a class, and the possibility of joining it, may act as a general incentive to enterprise and effort affecting a considerable number of producers, so that general productivity may not suffer to the full extent. But the burden on the standard, due to the defective population, is a dead weight burden, without any such compensating secondary counterweights.

What is its magnitude, as a subtraction from the ordinary order of the standard? Let us take the direct burden. According to recent reports there are 300,000 defectives of all ages in England and Wales. If they were all non-producers, at about £65 per annum each they represent a total deduction of £19,500,000. This represents a maximum, because of course by no means all the defectives are non-producers, and many are earning something. We must remember that many of them are either below or above the earning age, but I make no deduction because I assume that in a eugenic scheme they would not exist at all. So I assume some £15 millions is the dead weight burden. This is less than 6d. a week from the ordinary income as a deduction, and may be taken as the direct effect. I ignore the direct costs of criminality, etc., as it is unproven whether the proportion is greater from this section. (Vide *Mental Hygiene*, January 1929.)

But there are two considerations at this point. The taxation or other deduction from wealth to supply the fund is not merely a reduction of income, it is a depressant to general enterprise. It is easy to ex-

aggerate the effect of taxation of this range, and there are some counter-effects which would take me too far into the field of economic psychology. In general, there is no direct relation between height of wages and intensity of work—the only real depressant is a direct tax consciously paid and resented.[1]

The second point is more material. I have assumed so far that the section of defectives would no longer exist, and there would be a clear deduction of that number from the population. But defectives do not result wholly from the mating of people all defective. A defective may be born to parents of whom one only would count as defective, and the eugenic fulfilment would leave the sound parent in being as the potential mate of another sound person. In other words, the birth of defectives is not wholly additive, but stands in part in place of potential sound births that do not take place. How many sound people mate with defectives, and if there were no defectives, would mate with sound people at present unmated? As there is a surplus of women already, this process could only make additions to their ranks, and give no further births. But in so far as sound males are now mating with female defectives, they would then be able to mate with sound females, who are now surplus, and additional sound population would result.[2] This addition would add to the total mass of production, but only a per-head addition, and would scarcely raise the standard of life of all the rest of the workers, so that the calculation already made is not really affected.

[1] Vide my *Motive and Method in a Christian Order*, ch. iii.

[2] Vide *Eugenics Review*, vol. xxi., April 1929, p. 69, on the statistical tendencies of these mixed marriages.

The discussion has so far been on the static influence of mental deficiency. Its progressive influence, now assumed to be checked by eugenics, might be far worse. Some people see nothing but a kind of racial genetic entropy ahead of us, and a stock of deficients, not only increasing absolutely, but also, in a relatively stationary population, becoming a progressively larger fraction of the population, with a general depreciation of the quality of the stock which is mentally competent. The Brock report was reassuring, so that this appears an exaggerated view. On the other hand, it is quite possible to conceive a society in which the standard of life is continually being raised by individual genius and mass scientific talent, and enjoyed by the mass of people who themselves contribute less and less to its efficiency, and are more and more parasitic upon their environment and social heritage for the good life. It is not possible, therefore, to make any economic assessment of the long-run effects of the removal of defectives, as distinct from a general qualitative change. But there is no reason to suppose that that effect in the long run will be less than in the short run.

Inheritance of Acquired Talent

If genius is elusive, but certainly not in any danger from the elimination of aments, what shall we say of talent and general educability ? It is natural for anyone nursing any doctrine of social progress to cherish a belief that somehow the inheritability of acquired characters must eventually be scientifically established, despite all the abortive or negative attempts that have piled up in the effort to revert from Weis-

mann to Lamarck. If rats obey Professor McBride, the outlook gets rosy. If they are obstinate, we may decline to acknowledge that what obtains in physical or physiological reaction has any necessary relevance to the possibilities of human intelligence. We welcome Mr. Dufton's recent contribution to the British Association, indicating that capability is in no small degree an acquired character, and is directly transmitted, so that there is a significant correlation between the age of parents and the ability, or rather attainment, of the sons and, less emphatically, of the daughters.[1]

But we cannot doubt that the balance of most recent teaching is definitely against much optimism in this direction. The Spencerian doctrine of social progress, from which we have now well emerged, certainly rested implicitly on a high degree of such inheritance. But we may take our position anywhere on the long line from, let us say, Benjamin Kidd at one end to Alderton Pink at the other, both of whom have applied the latest biological or genetical findings of their day to the social problem. Kidd, in the *Science of Power*, had a pathetic belief in the power to make an almost instant change in the mass: "Give us the young and we will create a new mind, and a new earth in a single generation". He was to do this, I know, not so much by inborn heredity as by social heredity, which he said had been inextricably confused. But unless the infant life was taken from its mother instantly at birth, the whole complex of fears and aptitudes was mysteriously conveyed to it in a few

[1] *Eugenics Review*, vol. xxv., January 1934, p. 245. *Vide* also Major Hinton on 'Habit and Environment', *Eugenics Review*, vol. xix., July 1927.

moments of time. At any rate, however defective his experiments, or his reasoning from them, may have been, they led opinion to the extreme educability of the race. Pink, on the other hand, is the arch pessimist. The vast mass have now only the most limited educability, and never can have more. Non-heritability has such a blind hold on the race that democracy is a pathetic impossibility, education having the most complete finality in diminishing returns. But increasing the proportion of educability by breeding *is* a possibility, and, as Aldous Huxley says in his preface to Pink's *Realist looks at Democracy*, education can only bring increasing returns on one condition. No form of social progress is possible unless there is a continuous improvement of individuals. We can, of course, acknowledge that Spiller's 'interlearning' is the great agency of improving life. The *best* of each generation may contribute an advancing body of knowledge to the continuous environment, and the *mass* of each generation may, without any innate advance, enjoy a steadily advancing standard of life. As Professor Joad says: "I am contending, that is to say, not so much that I am the richer in vital endowment because of the efforts of my particular ancestors, though this may in some measure be true, but rather that the generation to which I belong enjoys life as a whole at a higher level and of a richer quality because of the acquisitions of all the preceding generations." [1] On the other hand, the environment may be conceived as relatively stationary, and each succeeding generation may inherently improve in its ability to absorb and utilize, and make that environment subjectively valuable. I cannot conceive that these alternatives are

[1] "The Meaning of Life."

really independent. The more complex the environment, the more qualities must be demanded by the average man and the civilization to master and manage it—it is not a matter merely of absorption, but, even if it were, he must be a continuously better man to withstand the processes of moral deterioration.

The Eugenic Programme

We must persevere, even at the risk of over-professionalization, encourage, and keep up the birth-rate in the section of real mental achievement. This is valuable whichever of the four agencies is valid and dominant, *i.e.* whether we are depending for our results upon genetic transmission of the natural ability which has led to the achievement; or upon some degree of transmission of the talent acquired by exercising such education, intensely and professionally; or upon the family environment and nurture created by the parents; or upon maintaining the aggregate of workers in the field of talented research and management. But even if it be proved that the doctrine held by Fisher and others is true, that the present type of society tends to " couple genetic qualities, making for economic and social success, with those making for low fertility ", even if it is true in the extreme event that those making high contributions to their generation are *pro tanto* less likely to make contributions by fertility to the future, I should not despair, provided the flow of new ability from the other ranks is kept strong and encouraged by every known device. This may be, indeed, the way nature intends to work, and the idea that every grade should be self-supporting

genetically seems to me *not* the only possible one for stable progress.

But in the present state of our knowledge we are fumbling with these inferences. "Until we have invented a method for distinguishing the effects of social environment from those of genetic constitution, we shall be wholly unable to say anything of the least scientific value on such vital topics as the possible genetic differences in intelligence, initiative, and aptitude which may distinguish different human groups." [1]

I have been discussing the influences of eugenic aims upon economic conditions, but we must look for a moment at economic means of promoting eugenic aims, in the well-worn topics of family allowances, migration, and differential taxation. If it is true that the method of computing unemployment relief, however justified from a humanitarian point of view, is dysgenic [2] it must probably also be true that a family allowance system in the lower paid ranks, not far removed in reward from unemployment pay, would be almost equally so. It might, therefore, be considered desirable to limit the range of allowance to several children or make it on a diminishing scale for additional births. But if it is desired to encourage the birth-rate at a different level, the system seems to be more defensible in the strata of professional and higher manual workers. The London School of Economics, having a certain sum with which to increase annual emoluments, decided to apply it in the form of children's allowances, and thus to afford the maximum real satisfaction with a sum which, evenly spread over all,

[1] Julian Huxley, A. C. Haddon, A. M. Carr-Saunders, *We Europeans.*

[2] Vide *Economic Journal*, Supplement, January 1929.

might have had little general effect. The Wesleyan Methodist Church has for long had such a connexional system. This seems to be thoroughly sound eugenically. I am not saying anything against the theoretical economic soundness of the general scheme, if practical ways can be found of working it. Society has in some way to maintain every factor of production, not only in its existing form, but also provide for its continuation and wastage. It does this clumsily now in a wage to every worker alike, which has this renewal allowance in it, whether he has responsibility for renewals, *i.e.* children, or not. The family allowance system would pay direct the net personal reward of the worker, and, through a central renewal fund, a children's allowance quite separately. Now if some renewals are of a type not so socially desirable as others, it may certainly be, if not actually dysgenic, not as highly eugenic as a more discriminating scheme. Children's allowances by way of taxation are not based on eugenic considerations, but upon the faculty principle of taxation in an attempt to adjust the marginal incomes to equality of sacrifice, according to unescapable subsistence obligations incapable of bearing taxation. There is all the difference between a subsidy of the *tax* upon the allowance, and the amount of the allowance itself. As a eugenic stimulus it is negligible, because negative, though as a removal of a dysgenic discrimination it is not to be despised. A bonus of the same sum, given positively, would have greater effect. Death duties differential by kinship are too involved for mention here.

It has been claimed, however, that the case for a scheme of family bounties has especial force owing to the new fact that the intelligence index of the popula-

tion is declining so rapidly as to endanger our safety. This is due to the rapidly decreasing birth-rate of the five higher grades of intelligence. "In order to keep pace with the recent advances of science and the rapid mechanization of human affairs it is necessary that the intelligence index of the general population should increase and not decline" [1]

German practice has been most conspicuous, partly by fiscal devices [2] and partly by direct bounty. No noticeable success has attended these efforts.

Much more is to be done by keeping open the educational ladder, and by facilitating rise for the slightest promise, not merely into black-coated ranks, but also into technical accomplishment. Still more may be done by raising the dignity of home service and help as a calling, so that young wives on not over-expansive incomes can rear several young children without the nightmare of domestic over-pressure. We must be prepared for a good deal of educational waste—people being as the Duke of Wellington said, "educated beyond their brains", in the hope that a slow deposit of general mental power may indeed be laid by each successive generation, but still more in the less theoretical and less unproved assumption that we shall get every promising personality on to the next rung of the ladder. The effect of promotion by seniority delaying marriage in the higher earnings and blocking the ladder of promotion is also important. How far the smallness of birth-rate in such classes is due to infertility is doubtful. Dr. Enid Charles says that recent tendencies do not confirm the alarmist assertions of eugenists

[1] C. C. Hurst, 'The Genetics of Intellect', *Eugenics Review*, 1935, p. 44.

[2] Vide my *Principles of Taxation*, 1936, chap. vi.

about the qualitative effects of differential fertility. She has an acute analysis of the connexion between "social promotion" and designed infertility, or the sifting out of the relatively sterile.[1] American writers attribute the apparent correlation between fertility and social status to a real direct association between marriage age and social status[2]; while a Swedish investigator finds the true fertility rate is 20 per cent higher in the highest social class than for the next, and the next is 15 per cent higher than the two lower classes, or that the sterility percentage is 24 per cent lower in the highest than the next, and that is 12 per cent lower than the lower middle class, which is 20 per cent again below the lowest.[3]

Meanwhile, let us make an ever-improving environment, not by means of cushions and buffers, but by eliminating, sifting, and sorting; by punishing, exacting standards, rewards, and incentives; also let us try experimental genetics in all directions, and then testing in human affairs by scientific means, even if free agency is retained. Perhaps we may realize the hope of an optimistic eugenist: "The power acquired by civilized man to control to-day, perhaps only the quantity, but to-morrow the quality of human life, will also enable man to change human nature and to raise mental and moral capacity to a higher level". Or even justify Dr. C. C. Hurst's peroration that man's destiny depends entirely on his response to the new knowledge, that if he so wills he can "create a race of supermen to enjoy life in a more comprehensive way than

[1] *Op. cit.* p. 131, etc.
[2] Dr. Frant Notestein in *Problems of Population.*
[3] Karl Edin, *Problems of Population,* p. 89.

we can hope to do".[1] It is difficult to pass beyond Lucretius:

> So, nought is lost that seems to pass away.
> Nature is aye rebuilding, and there comes
> Nothing to birth untouched by what is gone.[2]

My plea is that before every eugenic programme we pose the imminent question: What do I want to do in a stationary population?

[1] *The Mechanism of Creative Evolution*, p. 322.
[2] Denis Turner's translation.

CHAPTER III

THE CALCULUS OF PLENTY *

Creation and use of bountiful resources is the true aim of science applied to man's needs. The relation of parts to each other, and of the result to social desire, requires measurement and definition as the beginning of the science of social adjustment.

So far, we have considered the impact of science upon society in disturbance, with the general statement that it was compensated by subsequent enrichment through innovation. We have asked whether the price for this enrichment need be so high. But many people are asking rather that the enrichment itself should be greater and more immediate. More still are declaring that the enrichment is there but people cannot get enriched by it. There is 'poverty in the midst of plenty'. This again is by no means new.

Just a hundred years ago Thomas Carlyle in *Past and Present* was discussing England full of wealth, England dying of want—a powerful polemic of immense influence in his day, moving and provocative even in ours. "In the midst of plethoric plenty, the people perish," said he, and the background of this 'plenty' throughout his tirade is glut and over-production. "We accuse you of making above two

* Based upon the Norman Lockyer Lecture for 1935.

hundred thousand shirts for the barebacks of mankind. Too many shirts! Well, that is a novelty, in this intemperate earth, with its nine-hundred millions of bare backs." Men have made these shirts by order, men cannot get the reward of it. The word 'plenty' finds but occasional use to express this idea; it is less pungent and minatory than others, so that it occurs only twice in the book. As the years have gone on, the term 'plenty' still covers this glaring social maladjustment of things made, longed for, but unused. But gradually it has widened its content to mean much more, and in the last few years it has become, in its nebulous, over-suggestive and provocative complex, in a thousand headlines and titles, almost an intellectual menace. What it really stands for is, in all conscience, serious enough, and I have no desire to debunk it. But I do crave not to be overawed or confused by it. Articles and speeches on all sides pivot and pirouette on the phrase 'Poverty in the midst of plenty'. "The modern world suffering from the curse of plenty", says Mr. Winston Churchill; "from the paradox of impoverishment through plenty", says Sir Arthur Salter. Titles of books—*The Age of Plenty*, *Poverty in Plenty*, *The Pinch of Plenty*, *The Burden of Plenty*—follow in swift succession. In serious contexts the word spreads new tentacles of connotation, away from a static maladjustment or muddle to a dynamic relationship: "*As* productivity *increased*, effective demand *declined*, and the world found itself starving in the face of plenty".[1] Then comes a qualitative conception: "The task which confronts us, therefore, is not merely to satisfy hunger where it still exists, to liquidate scarcity and to put

[1] P. E. P. Broadsheet, No. 24.

plenty in its place, but to so guide the choice of the consumer that we shall choose . . . *the best type of plenty*. . . ." [1] Following this we get it meaning failure to snatch, not actualities, or even current potentialities, but the to-morrows of science realizable to-night: "It is not a problem of insufficiency, but of a new and almost incredible abundance. For the first time in human history we can speak of an opulent life released from drudgery for the whole community as a possibility for which *the means* are visible." [2]

A lyrical tribute to *The Age of Plenty*, just published by an American philosopher, Samuel Strauss, of newspaper and farming experience, has such a typical outburst as this:

> It is purposed to put forward, at this point, some few suggestions about plenty, about the nature of it, the meaning of it. The subject is a virgin one for inquiry, since the thing itself is fire-new and untried. The plenty of racial experience, the familiar plenty, the traditional seven years' kind, was never, of course, the real plenty, but only scarcity in its plenty aspect. Or it would sufficiently identify the old plenty to say that it was what existed in the scarcity ages when there was not privation.
>
> But the true plenty is not just the other side of scarcity. And it is not merely more than scarcity. Enough to go around is not simply a larger amount than too little to go around. It is not just quantitatively more. Plenty is enough to go around all of the time, and scarcity may be enough to go around some of the time, a little of the time, but the one is not simply more than the other; the difference is not merely quantitative. Plenty is numerically more, and it is also different in quality. For one thing, there are no degrees of scarcity. It was understandable to hear now of less and now of more scarcity, but to

[1] P. E. P. Broadsheet, No. 44.

[2] Henderson, *The Economic Consequences of Power Production.* (Italics mine. J. C. S.)

hear of more plenty and less plenty would be to hear things that would not go together in the mind. They would confuse the mind.

Plenty being plenty, and having in it no place for over-expansions and overcontractions, there is obviously omitted the passageway that was so important in scarcity, the passage-way between ups and downs, the systematic way down from up, the open sesame to another up. These passageways that were all of a piece with scarcity do not lie in plenty.

Plenty means flow. Ups and downs do not lie in it. If men, unconforming men, get in plenty's way, putting temporary obstacles before it, the consequences of their actions will not really be ups and downs, for ups and downs belong but in scarcity; they are not to plenty possible. What might continue to be called ups and downs—the habit acquired in the ages of scarcity is strong—would be only interruptions.

Plenty is another nature of thing than scarcity. It is a later thing than scarcity. But it does not follow because it is later that it is superior. It may mean an improved life, it may not. Plenty implicates another system, but the later system need not necessarily be the better one.

Now comes the latest encyclopaedic novel, *Summer Time Ends*, written, as we are told on the wrapper, with a " savage sense of the tragic absurdity of poverty amidst plenty ".

The Present Significance of the word 'Plenty'

It will be seen from some of these examples, and from many others within the recollection of the reader, that the general references to 'plenty' in its journalistic and platform use, and often in its more pretentious uses, cover a wide range of different circumstances to which very different economic principles, consequences, or causes attach. If they are constantly lumped to-

gether in this way, there can be no clear thinking about the problems suggested, and we remain, not in the spirit of scientific enquiry into the nature of the impact of science upon society, but in rhetorical and unprofitable, though seemingly intelligent, discussion, without any rudder or compass.

A little consideration shows that all the cases are covered by a main threefold classification with various subheads. First, the plenty of physical or scientific potentiality; second, the plenty of unused or unmarketed production; third, the plenty of unused capacity.

The plenty of potentiality is mainly an engineer's and scientist's conception, and the idea was brought to its highest point in the technocracy boom, which has left its sinister trail of dreams and pseudo-statistics over the whole field of thought and enquiry, a wreckage of irresponsible optimism which impedes smooth and orderly movement. Generally speaking, it expresses the facts of output in terms of reduced man power for a given output, and it therefore suggests that much reduced costs are available for the consumption now existing. So far it does not assert 'plenty'. But the immediate suggestion to the mind is that with reduced costs we should all either consume more at lower prices per unit, or else that the sales would be extended to people at present unable to afford the article—both assumptions often justified by experience. But the crude figures of engineering potentiality need to be qualified before the net figures of economic potentiality are deduced. The Brookings Institute enquiry into American capacity declared: "By ignoring the practical considerations which govern actual productive output (apart from restricted de-

mand) the Technocrats and others have been able to paint a picture of stupendous productive capacity—it seems necessary, however, to go beyond purely engineering concepts and face the problem of productive capacity in severely realistic terms". First, on the manufacturing side can all the attendant supplies and processes be speeded up to correspond? Does the human element stand up to the change? Is the full and even load postulated at particular places really available? But on the demand or economic side, supposing a considerably lower price is possible for the larger quantities available, after allowing for every production difficulty, what quantity will be taken off by the public at *that* price or at *any* price?

A quick limit of sale at any price at all is reached with many commodities, and 'plenty' is meaningless beyond a figure of supply which is harmonious with other factors of life. It might be a boon to make 100 fire-grates with the ease with which one is now made, and yet not really a greater boon, in any realistic sense, to make 1000 for every one now. There might still be a large section of mankind without them at 6d. a piece if all the etceteras which they connote were unchanged in their cost and use. There would be a definite limit to the demand for morocco bound Shakespeares at a penny, quite short of Sir Arthur Salter's famous Hottentot not particularly wanting a copy.

Every statement of technical multiples in production requires therefore much qualification and examination, before the plenty which it connotes can be determined. But in any case, there is a more serious limitation. If in fact there are only one or two such new machines in existence, and the bulk of supply comes from older equipment, the alleged plenty does

not actually exist, nor is it actually potential; it is only hypothetically or ultimately potential.

There is a long way between "the little more and how much it is" and "enough is as good as a feast". I do not suggest that the word 'plenty' has never until recently been used for potentiality as against actuality, or for technical possibility against economic and psychological relativity. These aspects have been reflected occasionally, but harmlessly, for centuries.

The earliest reference I have found to 'plenty' in this surcharged and suggestive sense, is in 1639, in Gabriel Plattes' *A discovery of infinite treasure, hidden since the world's beginning. Whereunto all men, of what degree soever, are friendly invited to be sharers with the discoverer.* Chapter XI. Wherein is shewed, that in these Ages, Inventions to save the number of mens workes, are not profitable to a Commonwealth overcharged with people, but rather the contrary." It runs:

> As for the new Inventions, for the saving of mens worke in an overpeopled Common-wealth, it is disputable whether they be for the generall good or not; yet in regard that the chiefe policie consisteth in finding out wayes, how the same quantitie of land may maintaine more people than it did before, which cannot be done any way, but by industrie of the people; therefore I conceive, that in the new Inventions, it is for the generall good to save mens workes by Engines; for if one workeman can doe as much with his Engine, as ten men can doe without it, there is nine mens maintenance saved to the Common-wealth; whereby *plenty* is increased to every one: I must needs confesse, that if the common practice in Husbandry now used, was to set their Corne the common way, that then the Engine newly invented for that purpose, might doe more hurt than good; for that so many would then want employment; as we see in London; there was an Invention

to grinde the Needles many at once, whereby halfe the Needle-makers had gone a begging, if the new device had not bin restrained; but in this case it is farre otherwayes, for here is imployment for many more people than before; though there be many mens workes saved, which would be lost working the rude way: also here is a great improvement in the quantitie of land; for by this meanes the new people set on worke doe get maintenance for many more than themselves, by their industry upon the same quantitie of land which would maintaine but a few before. And it is to be conceived, that when these inventions and Improvements shall be thoroughly put in practice, then the Common wealth will not be overpeopled; but rather there will want people to accomplish the worke, whereby it will appeare that the saving of mens workes will then be a profitable Invention.

It will be noticed that he seized the idea of plenty being increased to everyone, and realized the resultant unemployment if the demand for the product is limited, as with needles, but the gain, if demand was extensible, as for foodstuffs. He also appreciated some of the difference made by relative population, and even the effect of invention in stimulating population.

The Three Sources of Plenty

This current concept of Plenty, in its alliterative—and, therefore, popularly almost causative—association with Poverty, is thus fed from three main sources: the concept of things not hitherto made, but now capable of being made, the concept of things already made and standing unused, and the concept of things that have not, but could have, been made.

Based upon this concept of Plenty, provoked by it, leading out of it, are many different social and economic issues. Conceptions of a planned society, of a more

regulated society, of a self-integrated industrial order; theories of the economic cycle, of unemployment, of under-consumption, of redistribution of incomes, of population, of control of investment, and particularly of social credit and reinforcements of purchasing power; concern about the lag of man's ethical and moral capacity compared with either the bounty of providence, or of the laboratory; the failure of science to integrate with society; the shortcomings of economists, as scientists or as moralists; 'production for use and not for profit', and a host of allied contentious questions all get their impetus from Plenty.

It is not my purpose to touch any of these consequentials or derivatives, but rather to analyse *plenty*, mainly in its quantitative aspects, because according to the separate elements of its causation must depend diagnosis and the validity of all the reasoning which proceeds from the basic assumption of plenty. This discipline is a preliminary to any such scientific study of impact and welfare as I have pleaded for in Chapter I., for the technique of measurement is the beginning of the science of social adjustment.

Large dynamic ideas are scientifically dangerous if they remain unmeasured. Technological and scientific conceptions of plenty are capable of measurement and quantitative statement, but an accepted technique for this purpose is still lacking, and we have no recognized units of productivity capable of being fairly aggregated and compared. At this point I should be content with the idea of the *measurement* of plenty. But the problem goes much further: there is a sense in which factuality is not really actuality. An increase in boot-making machinery of 10 per cent has a certain signifi-

cance for plenty, a second and a third dose of 10 per cent may be factually similar, their measurement identical. But in actual relation to actual or wanted plenty, they are quite different. The age of each dose of factual plenty, its position in space or time in relation to the user, its difference in the cost of human co-operation, and, above all, the position of each dose in relation to the other doses, measured against the scale or curve or schedule of the psychology of human demand, all mean that the doses of apparent equality in measurement can be arranged in descending or receding order of practical value and significance and therefore price. The problem is a summation of successive equal units or magnitudes with receding (*a*) *time potentials* (where, for example, an invention can only be brought into full use gradually), (*b*) *cost potentials* (where fuller utilization of unused capacity involves greater proportionate expense for each unit), and (*c*), *demand potentials* (where increased supplies can only be sold at lower prices). I beg the term '*Calculus of Plenty*' as an indication of the scientific discipline which is necessary for the mind, when it proceeds from its composite concept of plenty to deductive inferences for human action and policy fraught with such importance for the world. The consideration will not lack practical utility even if it does not reach into any of the subjects dependent upon it, provided that it arranges and purifies the material for their use.

Technocracy and Potential Plenty

Let us examine first what has been said and done about the potentialities of science and invention,

nearly always quantitatively stated, with great apparent exactness, and conveying an impression not only of realizable plenty were it not for someone's stupidity or the faults of society, but also of assurance in magnitudes. The favourite quotation from technocracy was: "If you hand over complete control to us we will give every man jack of you the equivalent of $20,000 a year income for life in return for four hours' work a day, four days a week, ten months a year". Then came the isolated data on which such a promise could be based.

Technocracy proclaimed that a hundred men in modern brick plants working steadily can produce all the bricks the United States need. In pig-iron one man in one hour does what it took 650 hours to do 50 years ago, or in incandescent lamps as much in an hour as in 9000 hours in 1914. A Milwaukee plant with a daily capacity for 10,000 chassis frames and 34 miles of pipe-lines wants only 208 men. New houses, fully equipped, on a straight-line process, would come in 30 to 50 miles of 8 by 12 ft. sections a day, with only 200 operators. The technologist can produce a razor-blade with a tungsten-carbide edge at just 20 per cent additional cost of a blade to-day, but the blade would last a lifetime and put all the present equipment out. The introduction of ramie with its 22-inch fibre and the tenfold yield per acre compared with cotton, and with three crops a year, would, "smash up all the other textiles". He could make an automobile at a 50 per cent increase in price that would run 350,000 miles without an overhaul. Or shoes that would last $2\frac{1}{2}$ years and get a ten-years supply in 8 to 10 months. The adult population aged 25 to 45 need work only 660 hours a year to produce a standard

of living for the entire population ten times above that of 1929.[1]

The League of Nations Labour review reported on milking by machinery, a reduction from 156 minutes to 43 minutes for the herd of 26 cows. In the use of agricultural machinery many striking advances have been made.

The records of the past lend much support to confident claims for the future. The U.S. official statistics indicated that since 1909 there had been an increase of 49 per cent in the average output, or, for 100 men in production then only 67 are now needed. By a wider range of reasoning " America by 1886 was able to do without 17 million men who would once have been required to produce its output in that year. . . ."

In Australia in 20 years, 1907–27, the number of factory workers increased 87½ per cent but the output went up 300 per cent, or, allowing for money changes, 105 per cent, giving an increase per worker of 20 per cent—similar to America. The Dunlop Co. recorded a rise in *per capita* output 2½ times in five years. The Cunard change from coal to oil reduced their stokers from 951 to 263.

In the bootmaking industry in U.S.A. in 1900 there were 153,600 workers, in 1914 191,555, and in 1925 206,992, despite an enormous annual output of new machinery. In printing, the numbers went from 162,992 in 1900 to 251,276 in 1925, in which year the printing machinery produced was worth over $69 millions.

In the *Economic Consequences of Power Production*, Mr. F. Henderson takes the boot industry as a main example of complexity and difficulty at last conquered

[1] Wayne Parrish, *New Outlook*, December 1932.

by the machine. In Britain at the end of 1930 production per worker was 20 pairs per week, but in America it has risen to 35 and in Czechoslovakia to 40 pairs, the higher degree of organization in the parts being the secret. Until a short time ago, working costs were never lower than 30 per cent [1] as against 70 per cent for raw material, but in the Bata establishment the figures are 20 and 80 respectively.

Hard on the technocrats came the critics. Pig-iron productivity was 30-fold overstated, and should have been 23 not 650 times that of 50 years ago. Electric bulbs were 30-fold not 9000-fold. The 50,000 barrels of flour per day per man per flour-mill would mean a labour force of 17 men for the whole country, whereas the industry actually employed 27,000 men. The straight-line continuous brick plants should have produced the country's output with 68 men against the 35,000 *actually* employed in 1929. These two contrasts throw a flood of light on the technocrats' position. When he says the modern brick-mill "will produce," does he mean such mills actually do exist or are recognized professionally as practicable in a reasonable future ? Or only in the bold vision of the technocratic specialist ? Manufacturers may be a bit out of date, but to suggest they are paying wages to 35,000 when 100 would do, or to 27,000 instead of 17, is to suggest an almost inconceivable industrial benightedness.[2] Some of the processes of technocratic computation include (1) multiplying by three because the machine can work 24 hours and man 8, (2) seizing on an isolated process as in farming, where a machine

[1] F. Henderson, *op. cit.* p. 52.

[2] Struvsky, 'The Case against Technocracy', *New York Times Magazine*, 1933.

can do the work of 3000 men, and generalizing for all farming, despite the fact that in cotton-growing the speed is about the same as in 1840. He also seizes on the 9000-fold increase in glass-blowing, and forgets the 1,500,000 carpenters and masons "with whom machines count much more than in the time of Pharoah".[1]

The actual increased speed of the world is 75 times what it was before the machine age, not 3000, or even 9 million times, as these special processes prove.

It is interesting to note that despite the enormous advance of machinery in America, with decreasing rates of man-hours in production, there is little or no change in the percentage of people (over 10 years of age) employed in gainful occupations—39·5 per cent in 1900; 41·4 in 1910; 39·3 in 1920; 39·7 in 1930, and even in manufactures the steadiness holds good. Cigarette machines making 2500 a minute have replaced those producing 500, but from 1916 to 1930 consumption also increased fivefold.[2] "It is said that if all the people of China suddenly decided to add a few inches to the length of their blouses, it would require the entire cotton output of the U.S. to make up the difference."[3]

The Reduction of Gross to Net Physical Capacity

The gross possible theoretical or *technical* capacity based on engineering ideas, has to be brought down

[1] Struvsky, 'The Case against Technocracy', *New York Times Magazine*, 1933.

[2] Willard French, 'Has the Machine mastered Man?', *Advertising and Selling*, January 1933.

[3] *Ibid.* Here the anti-technocrats seem to have exaggerated in their turn, for it would only be true if each person had several blouses and wore out a number per annum.

to the more important *economic* capacity by a number of stages.

(1) A 100 per cent use is in practice unattainable: a part must serve as a reserve for shut-down, breakdown, repairs, irregularity of supplies and interruptions of power, or changes in feed of raw material, setting for different patterns, etc. In the case of the United States investigations, at the height of the boom in 1929, 20 per cent of the plant capacity theoretically available was not utilized. I term this the '*operating margin*'.

(2) If all industries supplying other industries, and not the final consumer's demand, were perfectly integrated and exactly matched, it might be possible to get a flow of production which fully employed them all. But as it is, industry A may be supplying industry B with all that B can take and yet itself not be fully extended. Alternatively, industry A might be at full output and yet not giving industry B all it could absorb. So there will be uneconomic or unco-ordinated capacity in either A or B to some extent in nearly all cases, and no strength of consumer demand for the final product can eliminate such maladjustment at any point of time. No doubt a tendency is at work always to level up in the long run, but as the long run never arrives, new maladjustments arise in other places, or the compensation is overdone. The *Iron Age* found that rolling mill capacity in the States was 14 per cent in excess of the capacity to make the ingots which would be fed into the rolls. We cannot be surprised, therefore, that during the period of enquiry into American capacity the operating ratios for the mineral and allied groups ranged all the way from 97 per cent for electrolytic copper to 51 per cent for

black-powder mills, the average over all being 83 per cent for 30 industries. It is surprising how quickly an intensified demand will bring out a limiting factor even in labour, certain types of skill, draughtsmen, etc. Labour became scarce in the Birmingham area in the engineering industry while unemployment figures were high all round.

It is obvious that the maximum flow of production or measure of unproduced plenty must be determined by the maxima of key positions—bottle-necks, if you will—and the surplus or maladjustments cannot properly be reckoned in possible plenty. Nor does it mean that the constricted supply points should always be widened out—that depends on the demand schedule. For example, even in 1929 the physical equipment of flour-milling in the United States was twice as great as that needed in any recent year, and "the industry has a greater amount of excess capacity than any other in the food products industries".[1] It could not be said from this that acreage under wheat ought to be doubled, and consumption also doubled per head, just to fit the middle machine capacity. This industry has been slowly contracting its capacity since 1905. I term this class of excess capacity '*unco-ordinated surplus capacity*'.

(3) Allied to the foregoing, but *not* due to lack of co-ordination, is plant which is by nature seasonally used to full capacity and idle or partly idle during the rest of the time. Such plant is found in the sugar industry, canning and preserving. For no purpose can this plant be deemed to have a yearly capacity equal to its seasonal capacity multiplied by the full term. It is '*seasonal surplus capacity*' but has no

[1] *America's Capacity to Produce.*

bearing on the problem of plenty.

(4) Two industries may have surplus capacity technically equal yet vastly different in '*practical demand potentiality*'. Let us suppose people are desiring radios more and more and pianos less and less, and not generally both. Abundant purchasing power means much greater demand for the one, very slight extra demand for the other. If the unused technical capacity in each industry at a time of depression is 50 per cent, can we possibly regard the potential 'plenty' as the aggregate of these two unused sets of plant? A like argument might arise for every pair of rival industries supplying a like need: gas stoves and electric fires, gas and electric lighting, but here the unused capacity, if large, is more overlapping and partly duplicated.

A similar question may arise within an industry itself. The boot and shoe industry in America is frequently given as a good example of excess plant capacity, but the Brookings enquiry points out some special factors. (*a*) Much machinery stands idle due to variations in style and lack of balance in productive operations, and (*b*) rapidly changing styles make it difficult to keep machinery in full use. But the equipment taking this into account was used to 85 to 90 per cent of the practically attainable in 1925 to 1929, while the final estimate was 80 per cent over all. (*c*) The practice of leasing machines gives rise to the general assumption that additional ones can be got at any time by anyone, and leads to an over-rating of capacity.

(5) We now come to a class of technical surplus capacity which is of great economic importance. I will illustrate from my own experience. During the

great depression in the iron and steel trades, the monthly report from my mineral manager on the L.M.S. Railway contained a statement of the blast-furnaces which had come into or gone out of blast. A total for the country was also given, with the number which were currently in blast—a very low percentage indeed. I had occasion to reflect that many of the furnaces included in this total were unlikely in any circumstances ever to come into blast again, and that, therefore, my percentage was entirely misleading as an indication of progress and possibility, whereupon the total numbers were revised by reference to true potentiality and reduced to less than a half. To indicate total tonnage capacity really potential and also in blast, is a further refinement which makes for a more definite view. The tonnage of ships laid up is not homogeneous. Its efficacy as 'plenty' varies with its specialized equipment, its speed, and the 'turn round' of its ports. These will certainly be inferior to the tonnage actually in use.

It is quite clear that a mere objective physical capacity for production at any price is no true indication of economic plenty in any useful sense. In the United States in every year since 1922 the capacity of blast furnaces abandoned has been greater than the capacity of new furnaces constructed.

In what sense does a unit which is unable to compete with more modern, or better designed, plants, under strong demand, deserve to rank in either a technical or an economic aggregate by which to measure a potential but rather doubtful or unattainable plenty? The German investigator said: "In general, only active plants have been counted in the determination of practical capacity, and plants which

were still idle in 1934 have not been considered. This is partly due to the difficulty in determining whether these plants are temporarily or permanently not in operation . . . plants which cannot compete even in periods of best business conditions can hardly be viewed in general as anything other than permanently not in operation."

As a practical test, I should say that when demand has strengthened to a point that entrepreneurs are actively providing new plant to meet it, while old and closed plants still cannot afford to start up or use their so-called capacity, we have the point at which it serves no good purpose to include the latter in any test of potential plenty. This is '*capacity technically displaced on rising demand*'.

(6) The more active and pungent science and invention are, the more likely they are to disturb the studied even ranks of productive capacity, and create temporary surpluses of plant. But if the injections of science are continuous, the surpluses, though different ones, are continuous too. Let shipping tonnage exactly equal the available brisk trade. Let this equation be disturbed by the addition of a new vessel with more tonnage and some new device. It works at a cheaper freight. The oldest and least serviceable which cannot exist at a lower freight than in the past becomes obsolescent actually at once, but the reality of this state is not given effect to for a lag in time. Its tonnage cannot really be prayed in aid of aggregate capacity or plenty, in any practical sense. It differs from capacity displaced by new or a rising demand, and becomes *displaced on a stationary* demand, or '*invention displacement*'.

(7) Allied to these types of *obsolescent* capacity is

'*economically misplaced capacity*'. If a large number of hot-houses had been erected by an enthusiast in Britain, capable of producing melons, could we say that there was a large unused capacity, or potential plenty, when every increase in demand brought in fresh supplies from Nature's abundance abroad, and left the hot-houses still empty? I suspect that modern exclusive nationalism and tariff barriers are creating a good deal of *economically misplaced capacity* of this type.

(8) We do not know enough of the basic laws of society to say with confidence, for an individualistic community, that it could ever proceed upon an unvarying economic course, upon an eternal even keel. Something in collective psychology, especially given a predisposing accidental variation from without, like a good or bad harvest or an invention, starts up a rhythm of less and more, a cycle of boom and depression. Let it be supposed that this rhythm is natural and essential to ultimate progress, that the world moves along best by pulsing, and that we have reduced the amplitude of its fluctuations to a minimum; let us suppose that at the peak 100 machines of a particular type are needed, but at the valley only 90, and that the variety range of 10 is a condition of vigorous economic life. What is the fair point from which to measure *special* shortage, from which to judge unused 'plenty'? Clearly not 100, but 95 at most. I might as well say that the carriage stock we maintain for the special burst of the August Holidays represents during the rest of the year 'plenty in the midst of poverty'. Let it be supposed that by increased purchasing power we use it all, then by hypothesis we need a new peak stock for August, unless the travel at that period is

to be no greater than in February, which is absurd. Before we can judge capacity as really *capable* of being absorbed in bad times, we must eliminate minimum '*cyclical surpluses*'. The science of social adjustment may need to recognize that perfect adjustment does not take the form of a straight line of progress. The best progress may be undulatory, or featured by discontinuities. It may conceivably be undulatory in three dimensions, like a spiral lying on its side, the direction of the parts being rarely the direction of the whole.

(9) A further spurious plenty is found in '*wasteful exploitation*'—the present plenty of ultimate poverty. The new scientific methods for cutting and pulping timber more rapidly are not ultimately 'plenty' unless reforestation with its effort made without immediate return—that is, its 'minus plenty'—proceeds as rapidly. Too easily, coal and oil getting may never really be plenty at all—certainly unless these processes conserve by producing most economically and not most prodigally, they are short-lived as plenty. Wrong cultivation by denuding a country of forest may lead to soil erosion. Julian Huxley has questioned whether 'highly scientific methods of motion study and the like, used to exploit the workmen's capacities in the interest of immediate output', instead of conserving them in the best interests of the community, may not be waste instead of plenty too.

At the same moment that men are being paid *not* to produce things or paid to make one blade of grass grow where two grew before, they are being warned that they have pillaged their soils and forests to such an extent that the country has only three generations of virile national existence, unless within twenty years

the attitude of millions of people towards this familiar kind of lavish plenty is so changed that they fight to conserve as much as they now do to exploit.[1]

In classifying these various adjustments we must not lose sight of the fact that allowances for them may to some extent overlap or duplicate—they are not entirely additive. We are not entitled to make each single computation in turn, *assuming all the other elements to remain unchanged*, and then to aggregate them. For we should then be like the man who said he had had a terrible time with his car and when asked what was wrong, replied: "Well, I bought a carburettor that saved 50 per cent of the petrol, an induction gadget that saved 30 per cent, and a sparking plug that saved 25 per cent, and after I had gone ten miles my petrol tank overflowed".

Actual Attempts at Measurement

We have now looked at the main elements, to be measured whenever measurement is possible, or an idea of quantity can be provided. Let us consider what attempts have been made in practice to measure capacity or scope, in the field of actual plant rather than of things over-produced, or of scientific potentiality in the future. I will take leading or typical measurements in England and Germany and the United States which are quite different, but which will show methods of approach and lacunae, and which may form the ultimate basis of a proper general technique.

In an investigation into labour displacement by machinery undertaken for the World Power Confer-

[1] M. L. Cooke, before the American Waterworks Association, May 7, 1935.

ence [1] Mr. Ferguson, finding that the rate of increase of machinery capacity exceeded that of the population and employed workers, asked whether the proportion of machinery capacity in use (compared with total capacity) exceeded the proportion of persons in employment (compared with the total number of employed persons). For the United Kingdom he found that the proportion of machinery in use to total capacity was 87½ per cent in 1924 and 87·3 in 1930, total capacity having increased 15 per cent. The number of unused workers increased 3 per cent, but of the totals 90 per cent were employed in 1924 against slightly over 84 per cent in 1930. But he points out that 1930 was not so typical a year as 1924, and the decline in the demand was probably responsible for a far greater amount of unemployment than the introduction of machinery, for the percentage unemployed 10·5 in 1924 fluctuated slightly till 1929, when it was 10·4, and then fell away to 16 per cent. Of course, decline in demand would also affect machine capacity in use, and he concluded that a definite displacement had taken place. I should prefer to say that increasing mechanization has diminished the man-hours required for producing a given product, and if this diminution is not, or cannot be, equally spread in reduced hours for all, it comes out in the unemployment of a section, until such a time as new objects of consumption, preferable to leisure, fill up increased hours of work again. It does not follow that hours must necessarily be wholly filled up again, if leisure becomes precious. Moreover, when fundamental needs are satisfied, and luxuries, such as radio sets, gardens, and travel, are becoming widespread, these connote an increased quan-

[1] *World Survey*, April 1935.

tum of leisure or they are not compassable and cannot be enjoyed. Work shorteners are leisure extenders, such as devices for relieving household duties, electric power, carpet cleaners, chromium fittings, and they help to extend the active market for the leisure fillers.

Mr. Ferguson's examination is not strictly a net capacity test, for it uses prime moving power machine capacity with estimated deductions. The Census of Production deducts from the gross capacity of prime movers 10 per cent for those driving generators, but a mechanical efficiency of 90 per cent is obtained only on large engines, so that Mr. Ferguson puts 83 per cent as nearer reality. But this reliance on power statistics ignores the growing efficiency of physical output per unit of power.

A recent German estimate of capacity to produce made by the Institute for Business Research [1] establishes a new standard unit to measure the proportion of productive capacity being used in the various industries. The proportion of actual work hours to total possible work hours for the working population is one thing—and from a human point of view the most important. But it is not what is being sought. The statistics of workers may also be used to test utilization of plant capacity if we establish the number of workers actually employed as a percentage of those who would be employed if plants worked at full capacity. The economical capacity practically attainable is more important than the technical capacity based on engineering concepts. It is stated that in practice maximum practical operating capacity lies 10, 15, or even 20 per cent below the technical maxima. The investigator here took as seasonal those industries with

[1] *Supplement to the Weekly Report*, September 18, 1935.

a maximum month's production 20 per cent (or more) above the average monthly production for the year, and for seasonal industries *capacity* was taken as the mean between the highest monthly production multiplied by 12, and the highest annual production. In so-called campaign industries (fruit preserving) capacity was taken as the highest monthly production multiplied by the number of months in the season.

The German test of *activity* was to ignore all plants which were not called into life in the best recent year, on the principle that plants which cannot compete even in periods of the best business conditions, can hardly be viewed in general as anything other than permanently not in operation.

In Germany industrial plants were operating in 1934 to 60 per cent of ' full capacity ' rising to 66 per cent for the first half of 1934 and 70 per cent in July 1935. In a table of the percentage of practical capacity utilized in different industries in 1934, there are variations from 42 per cent in iron and steel to 70 in paper and foodstuffs. The lowest components were 20 per cent for fancy porcelain and velvet weaving, due to a " change in style and tastes ", and a very low figure for pianos and guitars, due to the change over to radio sets. In 1935 the motor vehicle industry has been working almost to full capacity. In several industries a point has been reached where the less profitable plants are in operation again, and consideration of new plants would be more active if it were not for the primacy of the State in drawing on available finance, " thus making it rather difficult for private persons or organizations to secure long term capital through bond or stock issues ".

The American enquiry was a deliberate examina-

tion of the commonplace charge of ' excess industrial capacity ' and it was found that it did not mean there was in fact a superfluity of fixed capital in the strictly economic sense. It went back to 1900, but took the period 1925 to 1929 as a kind of mark from which to measure intensively. As with us, many industries keep very imperfect records of capacity, and, " even in the case of those that do keep records, the figures that pass current in the trade are often incomplete, inflated, ambiguous, or subject to various types of distortion ". But many ingenious devices were adopted to get some degree of accuracy by sampling and otherwise. In bituminous coal 17 per cent of capacity of active mines was unutilized and idle mines would have added another 17 per cent ; anthracite had a spare 20 per cent and the by-product industry has normally run up to 90 per cent of capacity, passing 95 in 1929. In crude oil exceptional conditions existed, for there was wasteful drilling up to 1927 and after that the depression brought out surplus capacity. This industry does not illustrate the hypothesis of ' progressive increase in the margin between capacity and use '. Copper has a remarkable history on this point, however, going to 97 per cent of practical capacity in 1929, for during a 25-year period of expansion there has been " no long term change in the ratio of capacity to demand ". Seasonal demand is illustrated by Portland Cement in which " 17 per cent of rated capacity is unavailable because of the seasons ".

In meat-packing they worked to 86 per cent of practicable capacity, in the dairy industry from 90 to 95 per cent, despite great growth. The seasonal canning industry worked to 80 or 85 on a specially adjusted basis of computation, and beet sugar similarly

to 70 per cent. Cotton spinning presented statistical difficulties because of the irregularity of double shifting, but it ran to an 80 per cent utilization; but woollen ran much lower, owing to the competition of rayon reaching to 100 per cent even during the depression, and silk went over 90 per cent on a single, and 64 per cent on a double shift basis. Automobiles averaged 83 per cent, paper-making (with special conditions in its favour, such as modernization instead of abandonment of machinery) was 90 per cent. Blast-furnaces averaged 85·3 per cent, steel 93·2, rolled products 73·9 per cent, locomotive plants only 40 per cent, owing to more efficient train operation, textile machinery 55 per cent, machine tools 71·3 per cent. The lumber industry utilized ratio capacity to 65 per cent with a practical operating ratio of about 72 per cent. Plate glass had 85 per cent.

The general conclusion for manufacture was that there has been no decisive long-run tendency for capacity to increase at a more rapid rate than utilization. As a whole, 80 per cent of practical capacity for the years 1925–29 was utilized. But it did not follow that the balance of 20 per cent could actually come into production, and what I have termed uncoordinated surplus capacity and practical demand potentiality are urged, although undue elasticity of demand for some lines is also put forward. Finally, my fifth heading, 'capacity technically displaced on rising demand', is mentioned. In the services, electric power had about 20 per cent further available capacity, transportation fully 50, and grain elevator capacity 26 per cent. Over all, available plant was used between 80 and 83 per cent of capacity. Stated another way: American industry has not been increasing its

margin of unused capacity, 19 per cent being a fair net estimate of the amount of added production of which the plant was technically capable. They were not living in a fool's-paradise, or failing to maintain equipment. There is a warning that full production along current lines would have piled up surpluses of some goods, but if 'new productive effort' were directed towards co-ordinating the various industries, the most serious limitations would be removed, and in that adequate allowance for the failure of complete co-ordination indicates that an output of 19 per cent greater than was realized would have been possible. In the correlative study, *America's Capacity to Consume*, it was concluded that the United States could not materially shorten the working day and still produce the quantity of goods and services which the American people aspire to consume.

There are many cases of the examination of capacity in relation to demand in *particular* industries, not for a national view of capacity as a whole, but for particular practical purposes of the industry itself, and proceeding, of course, mainly with those purposes in view. They are too numerous to be mentioned here, but most of them would not suffer in value by being subjected to scrutiny from the different standpoints and with the principles I have indicated. The iron and steel industry, the shipbuilding industry, have technical estimates, but these estimates of an individual character are usually sketchy in the analysis of demand and in integration to other industries. A good recent attempt was made in the Master Cotton Spinners' Reorganization Scheme for the Cotton Industry, where the redundant capacity was estimated at 13½ million spindles (of which 9½ millions were in the American

section) and it was considered that if this excess were removed the industry would be left with 30 million spindles and would be able to work at 100 per cent capacity. But although this excess was 31 per cent of the whole, it was proposed to leave $3\frac{1}{2}$ million spindles or 8 per cent as a buffer against any future expansion in demand. As 70 per cent of the mills date from before 1910, we can measure to some extent the factor of obsolescence in this result.

Different Intensities of Demand

So far all the reductions of technical capacity to get true economic capacity have been, as the economist would say, on the 'supply' side. But let us suppose that there is efficient up-to-date plant for the production of article X which is only 70 per cent occupied, and that it *could* be all occupied without difficulty. Can we call the 30 per cent 'plenty in the midst of poverty' without further parley? Not without consideration of the demand side. If additional employment or spending power enhances total demand *at the same price* to take off enhanced total supply *at the same cost*, certainly we can. But if increased spending power gives a relatively less increased demand for this article and the increased supply is at a relatively higher cost, then certainly not. This is not the place to give the detailed economic analysis of elastic and inelastic demand schedules, and to match various degrees of such elasticity, with differing short-run supply curves at constant costs, at diminishing costs, and at increasing costs. But some indications must be given of those combination possibilities which preclude the new supply and these must negative the idea

that *certain* kinds of surplus capacity denote a plenty which is unborn through poverty. Demand may run in classes, *e.g.* considerable wealth standing against and supporting the production of some luxury like expensive china. A mere increase of mass purchasing power for the unemployed or a rise in wages for the employed might hardly touch this demand schedule, and a 50 per cent unused capacity at Copelands or Mintons might still remain 50 per cent—a kind of plant starvation in the midst of abounding prosperity. It is obvious that redistribution of wealth may bring about substantial changes. Again, the demand even by the million may be very inelastic so far as it comes from existing wage-earners, and depend for its increase entirely on re-employment. Demand for a necessity which has an enduring term, such as boots, may be of this type. Demand for wheat may be very little affected by improved wages—it may be positively reduced if the increase of purchasing power leads to the substitution of more fancy foods. But demand for bacon may rise both by the individual increase of wages, and the increase of the number of wage-earners.

Now it is well recognized that an increased supply can often be carried off or consumed only at a markedly lower price—we get further along the demand curve at a much lower level. Then, if the idle plant is in a condition where, the overheads being already covered and a profit resulting, an extra supply can be made at a lower unit cost for that extra, why not use the plant, make the additional supply, and market it at that lower price which is consistent with the larger demand? For the reason that, with a uniform product, there cannot be two market prices, and the new lower price must apply to the whole supply, including

that original portion made at the higher costs. So there is now a loss (or reduction of profit) on all the original bulk of the supply, and the loss has to be made good by the new sales. It may be demonstrated that another million people would travel if rail fares were reduced one-half, and indeed that filling the trains involves very little extra cost, so that the new revenue looks like clear profit. But if the existing ten million travellers have to be given the same reduction of fares, the gross receipts are greatly reduced, and the net profit too. People often talk as though apparent unused capacity could be called into abundance by a mere stimulation of purchasing power, all other things remaining equal, but the new supply fails to materialize under the conditions of the new demand, if that demand is of an elastic kind, and particularly if the new units demanded are additional units on existing individual budgets.

It will now be still more apparent why I laid such stress in preceding chapters upon the rate of increase of population as a solvent of the difficulties caused by the injection of innovation and invention into the economic machine.

Taking the example of the boot supply, I may quote Dr. Snow, writing in another connexion: "The purchasing power of the producer is only maintained if there is a regular and profitable market for the things he produces. To produce an extra million pairs of boots now is a very easy matter and there are many tempting inducements to do so, but to get them used on the top of the normal production is extremely difficult. There are empty factories in northern towns which can be used, merely by paying the ground rent on the land. Up-to-date machinery and equip-

ment can be obtained at an annual rent, and the local authorities will provide power and lighting on very attractive terms. The temptation for men with the requisite qualifications to use these facilities which enable them to produce substantially cheaper than established firms is great, but in the absence of any corresponding inducements to wear out these extra boots, the slow growth of population is a limiting factor in the expansion of demand." [1]

I may pass from a manufacturing example to an agricultural one.

Dr. Snow has pointed out that, before the war, we adjusted our economic machine on the basis of an annual increase of 2 per cent in our total food supplies, and thus brought about a 5 per cent increase in our imports of foodstuffs annually. But there came a long period in which our consumption (by weight) increased by less than $\frac{1}{4}$ per cent per annum, which required only 1 per cent in imports. Our export machinery based on paying for a 5 per cent intake had now only one-fifth to cope with, and Dr. Snow considers that "this simple fact was at the bottom of many of the world's economic troubles". Both Australia and Argentina went on expanding production in the habit of a 5 per cent expansion, without any recognition of the complete change in demand conditions, and the cessation of growth of population in the chief market. When responsible statesmen in Australia say there should be no restriction of any kind on anything that Australia wants to send here, it is clear that the growth factor has been ignored.[2] It is true that

[1] *Journal of Royal Statistical Society*, 1935.

[2] Dr. E. C. Snow, 'The Limits of Industrial Employment' (*Journal of Royal Statistical Society*, 1935).

an increase *per capita* could have an important effect, but, with more money than ever spent on foodstuffs, a diversion to non-staple varieties is obvious, and a decreased consumption of wheat *per capita* is no clear evidence of poverty.

The demand for food, drink, and tobacco imports has been averaging not more than 1 per cent per annum increase for some time, and this is not due to straitened circumstances, for it comes out of the greatest rise in real wages on record. The fall in the money wage rates since 1920–21 has been negligible, the fall in prices very considerable, so that a range of extra purchasing power has been available. It has been used for travel, amusement, savings, and other amenities as well as food, and the failure to buy more food is a clear case of relative elasticity in demand and not of poverty. It is particularly marked in the case of wheat.

But a case of demand elasticity in imports has a profound effect upon employment in export trades, and a different kind of ' plenty in the midst of poverty ' ensues.

Gluts, Over-production, Restriction and Destruction

We now pass to the third aspect, over-production, a visible surplus of goods that is held up in Restriction Schemes, Federal Farm Boards, Wheat Pools, or is even being destroyed wilfully. The last is by no means entirely a modern phenomenon, for the throwing overboard of Eastern produce to maintain the price of the remainder has on occasion been the producers' strike against an elastic demand schedule. Adam Smith

records that the Dutch burnt the spices which a fertile season produced beyond what they expected to dispose of in Europe with a sufficient profit.[1] But somehow this destruction of actually produced wealth, when men are in need, strikes the imagination much more than mere unused capacity, for it seems so wanton. Men do not feel it is 'better to have grown and burnt than never to have grown at all'. In accumulated stocks, viewed as plenty, there seems at first to be no problem of measurement or analysis—a plain physical fact, so many bushels or tons. But stocks 'carried over' have not all the same quality. A glut of plums in Worcestershire, not worth the cost of picking and getting to market, is not effectively 'plenty'. But if there is a canning factory then it may well be plenty, although the demand schedule for canned fruit is quite another thing than that for fresh fruit. Some carry-over is effectively imperishable, if, subject to ultimate deterioration, it ranks first for consumption, and if the next carry-over of identical magnitude is out of the new crop. There is obviously a *quality of position*, for a surplus, in tons of produce in Australia, can well be different from tons in Smithfield. Badly distributed surplus gold has one kind of capacity as plenty, quite different from the capacity of surplus unused credit facilities, which, unlike gold blocks, may disappear if they are delocalized.

Apart from these differentials, surplus of produced plenty has little problem of measurement on the supply side, but it shares much the same difficulties as unused capacity on the demand side. I do not intend to survey the wide range of surplus diamonds, tin, rubber, and other commodities, of cotton ploughed

[1] *Wealth of Nations*, iv. 7.

into the land, and goods destroyed. Two cases must suffice. They show the necessity for relating surpluses to total normal consumption in discussions of Plenty.

Perhaps the best-known example of the actual destruction of plenty is the recent burning of coffee in Brazil. Between 1931 and March 1934 some 27 million bags of coffee, equivalent to nearly two years' requirements, were destroyed. Not everybody realized that the probable cause of the whole episode was an attempt on the part of the producers not merely to maintain prices, but to raise them. The Brazilian Coffee Valorization Scheme had the effect of encouraging new planting, and was responsible for the excess of supply over demand at that price. The remedy was wholesale destruction. With a smaller harvest in 1934–35 it was thought that a gradual readjustment between supply and demand would be brought about, and a more remunerative level of price.[1]

The excess supply of wheat of late years seems enormous when stated absolutely in bushels. But if it is measured in relation to the total consumption it becomes more reasonable. The total consumption in six years (excluding the supplies of Russia and China internally produced and consumed) was 21,683 million bushels, and the carry-over at the end of the period was 444 millions greater than at the beginning in August 1928. Thus only 2·05 per cent of the supply was unconsumed. *Per capita* consumption declined during the period. "If it has not done so, the world would have used in the time 710 million bushels more than it did use and not only would there have been no excess, but the world would have been seriously short of necessary working stocks. Even if normal

[1] See *The Economist*, June 2, 1934.

consumption had not been maintained, it would have required, for example, only the eating of an extra slice of bread out of every 50, and the throwing of an occasional extra handful of wheat to the chickens, to have balanced demand to supply." [1] The same writer complains that the price to the consumer has been made relatively high in the great markets compared with the general consumers of the world. "In some important consuming countries prices are forced up to two or three times the levels that would normally correspond with the basic prices in the great primary markets. Price is so heavily loaded against the consumer, that the normal reactions to changes in supply prospects or primary market fluctuations do not occur." The farmer is often blamed for not being so responsive on the supply side as the manufacturer, and not contracting supply quickly enough on an oversupplied condition of the market. The argument also runs that the various countries during the war extended their acreage beyond normal needs, and then later tried to protect their own uneconomic production, leaving producers overseas with huge superfluous stocks on hand. Primary producers really need more rationalization than industrialists, and international agreement about the special localities devoted to particular products. In extenuation it has been said first, that supply is in so many hands, and so scattered, that collective response is more difficult and of a different order; second, that it is very difficult to contract acreage without a loss of invested capital quite unmatched in a factory, where the machine loses nothing by the stoppage; and third, that heavy farm

[1] Address by W. Sanford Evans, of Winnipeg, before the Grain Market Analysts' Club, Chicago, December 12, 1934.

mortgages compel the farmer, on a fall in prices, instead of contracting supply, to produce more in order to make up a money total of interest by large supply at the lower price—a vicious circle. A second line of attack upon the farmer, especially as regards the Dominions, is that he has become so accustomed to automatic extensions of acreage being met by increase of world population, that he has failed to note the slackening in the latter, and is in for a rude shock; in fact, is already experiencing the result of his lack of careful computation of demand, combined with automatic instinctive increase in supply. But the criticism seems hardly justified if a mere maintenance of *per capita* consumption, without reference to changes in the rate of increase, would have been enough to absorb all the recent output.

The Measurement of Invention 'Plenty'

When an inventor has discovered a new process, which gives the technocrat striking figures of potential plenty, how can we evaluate it? If it is an invention which makes existing objects of demand more easily we get one set of conditions—if it is a new object of demand, quite another. In the first case, there is a definite relation between the period of physical life of existing plant, its renewal and its obsolescence, which gives maximum social advantage and which we have discussed already. Often innovations take a long while to get fully adopted if their margin of advantage is not revolutionary and only comes in gradually on renewal programmes. Often, again, the major profits do not go to the first comers, the new inventions have long teething troubles, and those who wait a little avoid

much badly invested capital. Yet pioneer capital is an essential stage. Often capital is shy until proof is positive. The laboratory case may be proved up to the hilt, the engineer may be positive, but the capital market is slow-moving. And there is no reason to suppose that socially owned capital, which loves to play for committee and voter safety, and adopt private success when it is proved, would be more progressive and risk-taking than privately subscribed capital. There is a long practical lag between the plenty of the idea and the plenty of the fact. As a rough estimate, I should put it as an average of one-half of the physical life of existing plant. In the case of new objects of demand, there is no discernible mode of the number of years before an idea is adopted.[1]

In dealing with 'Invention as an Economic Factor'[2] several years ago, I compared the incidence of discovery and science upon a society resistant to change with one which was adjusted and organized for change with minimum personal hardship. In tracing the effect of invention upon economic profit, I there indicated that for the industries with heavy expenditure in fixed capital, inventions with moderate advantages would require long periods for domination, by way of renewal programmes because the obsolescence costs would not otherwise be covered. But with an expanding demand, and a large advantage, the range of differentials in economic profits would be quickly closed up. On the whole, I inclined to the view that periods of rapid and important invention tend to be periods of larger but shorter-period differential profits.

[1] My estimates in Chapter I refer rather to institutional adjustments than to production.

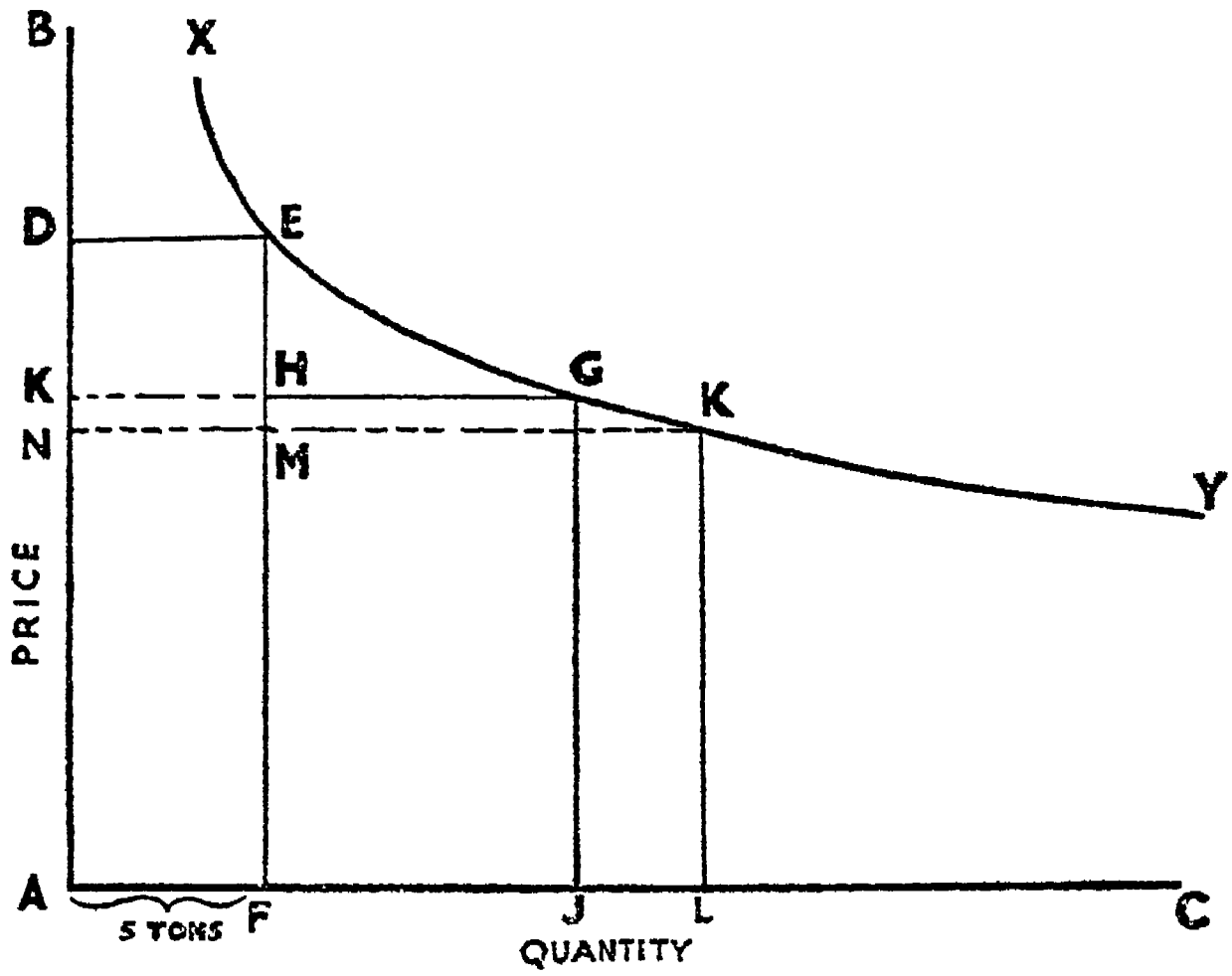
[2] *Some Economic Factors in Modern Life.*

The Measurement of the Subjective

Let us suppose that everything has been done on the physical, the scientific, industrial, and engineering sides to present us with purified or rationalized quantitative particulars of plenty in any of these three orders. We have still to consider the question of demand. There may be a million tons of x worth £200 a ton at the ruling price, and a million tons of y at the same price, and one may represent much greater real plenty than the other, if the demand schedule in one case is such that the stock will be absorbed at slight reductions of price, while the other has a different intensity of demand and needs enormous reductions to make it go off at all. For these differences are the measure of the force of that human desire which alone makes objects wealth. How can this subjective element be measured against the objective stock? This takes us beyond the physical and engineering field within which this chapter lies, into the field of economic analysis of demand and supply schedules and statistical correlation, which is beyond our present scope, along an unexplored line. But perhaps I may indicate some possible lines of attack. In all these quantitative statements *time* is an essential element. Let us take as our unit of plenty, for example, 5 per cent of an assumed annual normally absorbed supply of 100 tons of x, viz. a *prime* unit of 5 tons, and assume also that *by itself* it would sell at £195 per ton, giving a total yield of £975. The next 'plenty unit' would be such a tonnage, say, 6 tons, that successfully fetching £162 : 10s., would also realize £975, the third 7 tons realizing £140 per ton and making the same total. In this way the whole 100 tons might comprise 10 'units

of plenty '. (But the demand curve would not necessarily be a continuous function—a price might be reached at which a very large demand would set in for some new alternative use, which would take away the whole lot.) Now the corresponding 100 tons of *y* might be subject to a much less intense demand, and there would be only 5 units of plenty in the whole amount. This device of mine is over-simplified—it is only an approach, for it ignores the fact that supplies are not coming out at a *series* of prices, but the lower price to carry off the less-wanted part applies to the whole. The second unit of plenty therefore would really have to be such an extra quantity at the lower price as would make a total money yield not only equal to the money yield of the first, but also enough to make good the deficit created on the assumed yield of the first at the second unit price. (In the case in question the rate of the second lot at £162 : 10s. would also fix the price of the first lot. There would be yield of 5 × £32 : 10s., or £162 : 10s. less, and there would have to be enough extra tonnage in the second ' plenty unit ' to make good this loss, a total tonnage on the second at some lower price than £162 : 10s. actually.) For some purposes such material devices would be sufficiently significant of the differences between two apparently equal quantities of plenty. For others it would be necessary to take costs into account, and aggregate units, not of like gross yields, but net yields. Although our concrete knowledge of demand schedules is only growing slowly, there will be in general enough experience to show which commodities have highly inelastic and which very elastic, demand, and this may suffice for broad assessments of the significance of plenty. Of course, the demand I have just been

contemplating is short-period demand. The differences that would come about through changing aggregate demand power through different causes is profound. Increasing population with stationary standards, increasing standards with stationary population, changing age levels, greater freedom of international trade; stimulation of employment through



government money from borrowing, from taxing, from inflation; enhancement of purchasing power through bolder credit, especially through credit schemes of the Douglas type; these are the chief originating differences.[1]

We may be fully alive to the importance of the

[1] Let the line A—B represent price, and the line A—C quantity, such that the demand curve *x*—*y* gives at any point along it the price (at the same height as along A—B) at which a given quantity (at the same length as measured along A—C) can be sold. Let the prime unit of quantity be five tons, and let this be measured along A—C at F—the price will be D, being the point along A—B where D—E parallel to the base cuts the demand curve *x*—*y*. Then the unit of equal demand is (price per ton *x* the prime unit of quantity) represented by the rectangle

great subjects which are superimposed upon the concept of plenty, and yet pause to plead for a greater discrimination in treatment and some beginning at measurement and common units of thought, to clarify our discussion and subsequent analysis. We cannot repeat too often Lord Kelvin's dictum that we "never know much about anything until we have contrived to measure it". But we certainly do not know *all* about anything merely because we have measured it, and the realization of true plenty emerges as the main object of the science of social adjustment.

A—D—E—F. The second unit is found by a quantity F—J at a price G, such that the rectangle G—H—F—J is equal to A—D—E—F. But inasmuch as the price G will now apply to the quantity A—F also, the sale of F—J brings about a diminution of yield on A—F equal to the rectangle K—D—E—H, and a further quantity J—L must be sold so that the rectangle A—N—K—L is twice A—D—E—F and the quantity F—L is the second unit of tonnage for summation purposes in measuring the demand quality of the whole surplus of, say, 100 tons. (The difference between these two second units involves the validity of certain difficult economic conceptions about 'consumer's surplus' which are not for discussion here.)

CHAPTER IV

SOME PROJECTS OF RESEARCH

In the science of social adjustment, new or intensified research is required at scores of distinct points. Some examples are here given.

THE remark most frequently addressed to me, on the issues raised in the first chapter, is : " You have indicated what is wrong, but you have not told us what to do about it. What would you propose to do if you had the power ? " My answer is simply, " I do not know ". Nor, pending the ascertainment of many facts and the prosecution of much research, can I see how anyone can give an answer which is more than a guess or a badly informed wish. But I do know some of the directions in which I think intellectual effort is wanted in the first instance. Probably before any solution can be reached the initial research will reveal into which quarters enquiry should then be turned. In this chapter I can but indicate the kind of opening programme that I think would be profitable. I filled in the ' area of enquiry ' with a few descriptive headings (on p. 20) and even these have been the subject of curiosity, scepticism, and the reiteration : " What is your proposal under each ? " I shall now confine myself to an outline of what it is necessary to

search for under some of the subjects actually mentioned in the first chapter, without attempting to cover the whole field involved in the science of social adjustment.

But I must assume that we are proceeding without revolution from the basis of the *status quo*, and its further regulation, or modification by law, custom, and training. Much of the data that is being sought would, however, be equally necessary for wise government under a collectivist or totalitarian scheme, though I shall not attempt to indicate at each stage what is common to all government and forms of society and what is peculiar to the forms of regulated individualism in which we live.

Before coming to detailed studies, there are three perfectly general lines of action that are advisable.

I have indicated the immense significance that I attach to the population question, and the changed tempo of economic life which must result from the inescapable facts of the next twenty-five years. Our approach to its social problems is haphazard and piecemeal, but it is so important for the national welfare that I consider a Royal Commission should be set up forthwith (*a*) to examine and report upon the probable consequences of the decline in population and change in age groups to all our governmental and social services, national and local finance, and governmental institutions; and (*b*) to recommend what permanent agencies (existing, or to be formed) are required to deal with the problems as they develop, which shall initiate and promote remedial or protective measures, legislative or otherwise, as they become obvious and necessary. I believe that every aspect of our common life should be passed closely in review in the light of this population question.

In view of the shifts which have taken place, the huge aggregations of populations in new areas, and decreases in others, I think we must take a new view of census responsibilities. The relation between State and local finance rests upon elaborate formulae in which various population factors are prominent. For the lack of a proper inter-census in 1936 we shall continue to fumble with local estimates for years to come, and to be extrapolating from 1931 in an unsatisfactory fashion for another five years. A new census, and a decision to take one at five-year intervals, seem to me the imperative corollary of any appreciation of the local dynamic importance of the population problem. To this must be allied study of unemployment and of educational adjustments of major significance.

The third general action is the development of a practice, by the responsible body in each branch of science, of reviewing periodically the immediate hinterland of their subject. They should set out, for each period, what they deem to be the chief discoveries and improvements in their own field. These should be analysed into those which have received practical application in the social or economic field, either directly or through the medium of another branch of science. An estimate should be attempted of the effect of each in creating employment and embodying new capital, together with another estimate of any employment or capital displaced, and of changes brought about in the location of industry. It would probably be found that a common service of statistical technique would facilitate these *ad hoc* enquiries, and certainly one would be wanted for collating them and bringing them into a general picture. In some sciences, such as astronomy and mathematics, the 'products'

would all be only indirectly used, through physics. But the effort to work to a common schedule or questionnaire which would have to be reconciled in a common result, would develop a social awareness in the specialist, of greatest value in his later work. The earliest efforts would be crude and sketchy, but the point is that the right kind of specialists can contribute in an indispensable way, and might themselves gain greatly in so doing.

I do not propose to go beyond the subjects which were enumerated, rather as examples than as a formal classification, and they are taken only for the purpose of indicating the type of research that I regard as desirable. Certain leading threads or hypotheses are assumed throughout as a guide to examination: (1) the certain decline in population compared with the steady increase of the past; (2) the change in age-grouping; (3) the greater rapidity of change; (4) the desirability of expediting large changes; (5) the question of weighing the small advantages of slight changes in consumption to the community against any considerable disturbances to sections in production; (6) the necessity for a quicker human accommodation to such change as seems desirable after allowing for the cost.

Patent Rights

The underlying theory or philosophy of patent rights is by no means the same in all countries, for the historical evolution is different. In England the exception was made in favour of new inventions when restrictive privileges were abolished in 1623, but in America scientific progress was to be encouraged by giving inventors exclusive rights—these are the

negative and positive views respectively. In 1614 the Courts held, in the Ipswich Clothworkers case, that

> he only shall use such a trade or trafique for a certain time, *because at first the people of the Kingdom are ignorant*, and have not the knowledge or skill to use it . . . when the trade is become common, and others have been bound apprentices in the same trade, there is no reason that such should be forbidden to use it.

This is clearly the enunciation of the restriction of production in the *immediate* public interest, and not as a reward or an encouragement to the inventor.

The original British idea that a patent was a monopoly and should be regarded with disfavour by the law, has yielded before the French theory of the inventor's right as a natural right and the German idea of a bargain between the inventor and society.[1]

The three conceptions have coloured three areas of practice over the world. The economic basis prevalent throughout is now the idea that society recognizes the inventor's monopoly for a limited time in return for complete disclosure and cession of subsequent rights to society. Current literature on the subject shows that in many details patent laws are said to be out of touch with modern requirements, and although many alleged anomalies exist as between individuals, some of these technicalities may have a bearing upon the problem of ease of adoption of innovation, so that any general enquiry into the subject would cover questions addressed from this standpoint. For example, assuming the theory of social interest in an invention holds good, it is defeated if the patent system enables the

[1] S. P. Ladas, *Ency. of the Social Sciences.*

invention to be withheld from commercial use. If separate patents can be obtained by others for fine and not radical distinctions, competitive wastage, without commensurate social advantage, may result. More pertinent to my enquiry is the *period of protection*. This is commonly fourteen or fifteen years, up to twenty in some cases. This was conceived to be a proper term under conditions when the pace of life was slower, and the cycle of change much longer. The true question is whether this period is still the ideal one we should choose if we were starting *de novo* under modern conditions. If under the old conditions the average effective life of an idea before its supersession was thirty years, then ideas had half their life under private and half under social control. Now if we alter the life cycle to fifteen years without changing the patent conditions, we have the extraordinary result that effective ideas will, on the average, be living their whole lives under patent conditions, and social control is virtually confined to the superseded ones. It is *prima facie* inconceivable that the terms of a true bargain between society and the individual made in the light of conditions a century ago would be the ones we should choose if we started without preconceived notions to fit the conditions of to-day. It may well be that the ideal period should not be uniform, but have some relation to the amount of capital in the plant involved. Certainly the complications of obtaining patents under many different governments cannot be incurable. Even to cover the British Empire it is necessary to file over fifty patent applications. The theory of patent law was, moreover, elaborated before the days when the majority of discoveries emerged from large industrial laboratories through

employees. United States authorities allege that the system

> permits the creation of monopolies beyond the scope of a given patent and prevents the use of new inventions for the general good . . . if it be said that the scrapping of existing equipment is wasteful, the *decision thereon* should not be left with the monopolistic interests but with *an impartial authority which* would take into consideration the whole scheme of *interests involved.*

In general the discoverer of pure scientific ideas gets no protection or reward—this goes only to inventors who think out the applications.

Dr. Levinstein says that, owing to the concentration of industry into fewer, larger, and richer units than formerly, we should consider 'with a fresh mind' the effect of our system.

> Less than 1000 patents are granted annually which are worth while or justifiable [out of 37,000 applications], and approximately 20,000 are allowed to become void every year. At the most there ought to be at the present time no more than 14,500 patents in force, instead of nearly 130,000. If 95 per cent of the patents granted had been rejected, no great loss would have been inflicted on the patentee. More than one-half were, after four years, not worth a £5 note to their owners. For these four years, however, these valueless patents have blocked the way to others—they are bogus documents, making . . . menacing monopoly claims.[1]

Professor William Cramp has just made a powerful case for a Royal Commission to deal with patent law.[2] No doubt the impetus for this comes mainly from the desire to clear up anomalies between individuals. My

[1] Herbert Levinstein, 'British Patent Laws—Ancient and Modern' (*Journal of Soc. of Dyers and Colourists*, 1934, p. 83).

[2] British Association, 1936, Presidential Address to Sec. G.

plea is that advantage should be taken of this situation to see how much of the real viability of inventions is under private and how much under social control; to give definite protection and encouragement to important changes involving large-scale capital investment and direction of skilled labour, and specific location of it; to discourage all small incremental changes which make fidget and unrest on the productive side out of all proportion to advantage to the freely moving and fickle consumption side. The social side of the enquiry should be wide-ranging, and study the comparative effects of complete lack of protection in the sphere of medicine. Does it discourage discovery, and thus injure the community? There is a borderline between the two. When Sir Herbert Jackson hit on the idea of mounting an anti-cathode at an angle of 45° to the axis of the cathode beam, he laid the foundation of our standard forms of X-ray tubes. Sir Richard Gregory records that Jackson was urged by a scientific instrument-maker to protect his invention, and if he had done so he would have held the master patent of all such tubes and made a fortune from it.

> He decided deliberately to leave the device unprotected in order to encourage the scientific study of X-rays and their service to the human race. He thus sacrificed a personal profit on the altar of knowledge and manifested a spirit of which the world of science may well be proud.[1]

What, in fact, would be the difference in the economic state of the community if all patent protection were confined to a six-year period, and to cases where large capital and industrial interests in produc-

[1] *Proc. Royal Institution*, vol. xxix. p. 306.

tion were involved ? A recent conference on Business Education declared

Business men are realizing to-day that the rule of openness practised in science, medicine, and in the great business of agriculture, can be applied advantageously to themselves. In the place of profits made from the *ignorance* of competitors and hence from loss suffered by consumers, the leaders are ready to substitute the *differential* gain derived by emulation in wrestling secrets from nature and in utilizing this *freely divulged* knowledge with sagacity, speed, and skill of organization.[1]

The Hon. Alexander Shaw, in his Presidential Address to the Institute of Marine Engineers (October 6, 1936), said :

When I see the fuel bill for a voyage, say to Australia and back, of an elderly ship with the old-fashioned Scotch boilers and reciprocating engines, and compare the figure with the cost in fuel of propelling a much larger ship fitted with high-pressure steam and modern turbines on the same round voyage, then I take off my hat to the engineers. But, gentlemen, do not imagine that your skill is all jam for the shipowner. On the contrary, these unfortunate people have sunk millions of pounds in tonnage constructed shortly after the war and fitted with systems of propulsion which, although then modern, are now out of date. The resources to replace that elderly tonnage at once by modern ships simply do not exist. They have to be slowly and laboriously acquired by shipping concerns—and acquired largely by the operation of ships not now past their middle life, which must compete with vessels of the most modern kind supported in the case of many foreign countries by lavish subsidies from governments. So in a sense the engineer has sold the shipowner a pup ; for the very improvements which make a new ship less costly to run have the effect of rendering expensive in comparison the operation of ships which are not yet middle aged. . . .

The poor shipowner may be excused a sigh when he con-

[1] North-western University Conference on Business Education.

templates the possibility that vessels laid down to-day will in their turn be rendered obsolete by engineering advances perhaps only a few years ahead. The pace of science in these times is fast indeed, and shipping finance struggles after it with difficulty. It was not always so.

It may be necessary to draw a distinction between (*a*) new methods of producing consumers' goods, (*b*) new and different consumers' goods, (*c*) capital assets providing personal benefits. In any case, the facts on a wide scale concerning patents and invention and discovery have never been published or collected.

Invention Clearing

The marketing of invention, patenting, and final exploitation are still often a very individualistic hit-and-miss affair. Any business man in a prominent position knows how many ideas are being carried round looking for recognition and finance, to business men who have been once bitten and are twice shy, waiting some authoritative, unbiased verdict on their potentialities, while the investor himself is nervous of getting his ideas filched and improved upon by others. By wrong channels and inadequate backing, much inventive effort, after disturbing the market, goes to waste. A clearing house of scientists and financiers might, under a proper code of ethics, guarantee the inventor against imposition through exposing his ideas, give scientific judgment upon them, advise as to placing them, and eventually even help to finance them.[1] This Committee would be kept aware of parallel research and perhaps be instrumental in preventing duplication and overlapping. But the *prima facie* case for such

[1] Vide page 69.

an institution, national or international, has first to be established by careful research into the record of recent invention, and the extent to which, by the non-existence of conscious co-ordination, there is economic and human waste, and particularly of disturbance of the direction and stability of industry. I have been impressed with the haphazard way in which invention ideas 'get into' society and their fortuitous dependence on reaching the right man and the right purse at the right time. It needs scientific research of a close inductive type to determine how far this is a general state, and is capable of regulation in the social interest. Another scheme, drawn by Mr. S. T. Hayley, provides for a nucleus of subscribed capital to be used for help and protection, and to give both the public and the inventor a square deal.

Obsolescence Accountancy and Costing Regulations

Nearly all the customary ideas governing accountancy practice in making annual provision for producing plant are based on the length of physical life. This is decreasingly important, in fact, compared with the length of social life, and the latter conception ought to dominate the situation to a much greater extent than hitherto. If the cost of a productive machine has to be written off over fifteen years (its probable social life) instead of thirty years (its calculated physical life) in order to win the highest blessings of accountants' certificates and a reputation for conforming to the best standards of safe finance, it would mean that the initial costs of new production would be *higher* than hitherto. At the same time, the costs

of production from older machinery in danger of displacement thereby would be *lower* than hitherto. The comparative costing justification for introducing the new plant would have to be more exacting and considerable, and substitution would not take place wantonly or on too easy terms. Thus in all cases where the margin of advantage is real and tangible, the substitution would take place as it does now, but where it is trifling this method of treating obsolescence would tend to retard it. I am aware that special provision is often made by appropriation and is not treated as a true *cost*, so that, in any new method on the lines suggested, incorporation in costs, as well as treatment in the annual accounts, is an essential feature.

The Americans, of course, have very different ideas from the British on this subject of life. For example, I culled these two conceptions of 'age' on the same day:

> These old bridges were built in the horse-and-buggy days and were never intended to carry the cars, trucks, and buses of to-day. A large percentage of them were erected about the same time—some *thirty* years ago.[1]

> Streamlined cars stand outside their homes, while inside the family sits on creaking chairs of ancient lineage, bought twenty years ago![2]

We should now forget the term 'obsolescence' and deal with life as an effective social life. It is, indeed, less measurable, but close research into the facts of the past twenty years would provide a modal picture and give the basis for a proper treatment in accordance with this conception.

[1] H. E. Colburn, *Forgotten Bridges*.
[2] J. G. Frederick, 'Low Prices for Prosperity' (*Forum*).

Taxation Adjustments

The foregoing change would not have much chance of adoption if the new accountancy practice were not also recognized by the authorities in computing profits for taxation. But if it were so recognized, that fact would go a long way to help establish the practice. I have, in the past, been prominent in resisting the common business attempts to secure rates of depreciation or wear and tear higher than the physical facts of durability warrant, or to obtain claims for obsolescence beyond the present practice. Most of these claims are based on misconceptions and mares'-nests. The Inland Revenue allowances cover the physical life, and if the plant is superseded before that full allowance has been made, the lump sum difference outstanding is allowed, so that, by and large, the full 100 per cent cost (less scrap value) gets allowed for at some time and in some way. If manufacturers get a large allowance in the earlier years they must have smaller ones later, and many a one who would like double allowances now on recent acquisitions, forgets that he is still enjoying allowances for older plant which, under his own principles, would have long since ceased. The truth is that *in the long run*, on a stationary total of plant, it makes no difference.

The Inland Revenue allowance is based strictly on the idea of 'wear and tear', and is still somewhat imbued with the idea of the severely detached 'annual' character of the tax which was appropriate in 1878. If the tax were fully recognized as continuous, and average social life supplanted the concept of 'wear and tear', a practice might be allowed which would go far to consolidate its commercial use.

At first the Revenue would be giving larger allowances, and as the total plant in use was increasing, its total allowance would always be in advance of that given on present practice. But *in the long run* the aggregate allowances for industry would not exceed those at present given, for they must be equal to the *total annual replacement of machinery* and would equate this figure whether a hundred years' or one year's life were computed.[1]

Selective Direction of Financial Support in Research

The population problem in itself has a wide range. A group of experts in the Universities concerned to secure some diversion of research funds for this purpose have declared :

Within the field of the social sciences two specialisms are recognized by the academic world, economics and politics. They are characterized by the nature of their interest in the social mechanism ; while they both find some interest in all social phenomena, a limited range of social facts is of special relevance to each of them. Thus there are fields cultivated almost exclusively by economists and by political scientists respectively. At the same time these specialists are aware of the existence of territory, into which they occasionally make excursions, but which is on the whole neglected and unworked; for it is seldom that they are led to investigate the phenomena of marriage and the family, of social class, of the distribution of population and of social structure and organization in general, and, when they do so, it is merely incidentally and for limited and special purposes.

[1] The confusion of thought prevalent on aggregated ' wear and tear ' allowances is dealt with in my *British Incomes and Property*, pp. 196-98. Also my evidence before the Royal Commission on Income Tax, Q. 9758-9761.

We are especially concerned with this third field. Relatively to the older studies economics and politics may be under-developed, but relatively to economics and politics this third field is almost wholly neglected. The reason is clear. The social sciences are defined by the possession of a peculiar interest in, or angle of approach to, social phenomena. The interests of economists and of political scientists are well defined; and therefore economics and politics are recognized as subjects within the academic scheme. But no interest has yet emerged which links together those phenomena which are merely of limited and occasional interest to the recognized social sciences. In consequence these phenomena are not regarded as forming an academic subject and remain almost uninvestigated. It is true that some attention has recently been paid to these matters in schools of training for social work; but here the motive is the need of elementary factual knowledge for the purposes of vocational education. The result is serious in two ways. Economics and politics suffer from lack of balance which the scientific study of the remaining part of the field alone can provide; for there is no accurate knowledge of many aspects of the social structure, and there is no part of the social structure which is irrelevant to the interests of any social science. Secondly, it is difficult or impossible to deal adequately with many pressing social problems because no study of the facts has been made; in consequence social legislation often takes the form of shots in the dark.

They have drawn a programme of research as a coherent whole:

PART I—QUANTITATIVE

THE FACTORS INFLUENCING THE GROWTH AND DISTRIBUTION OF NUMBERS IN A COMMUNITY

1. Biological, social, and economic agencies affecting—
   (*a*) Fertility.
   (*b*) Change in character of marriage and the family group.
   (*c*) Differential mortality.

2. Resources available for maintaining population of a given size.
   (*a*) Basic material resources (bio-technical and metallurgical).
   (*b*) Unused physical productive capacity.
   (*c*) Unemployed human resources and their transferability and adaptability.
3. Regional distribution of population with respect to—
   (*a*) Location and localization of industry.
   (*b*) Agencies determining present distribution of population, intra- and international movements of population, growth of large towns.
   (*c*) Social consequences of increasing density of population and of occupational specialization.
4. Aggregate consumption of the community and demand for various types of labour as affected by regional and occupational distribution of population.

PART II—QUALITATIVE

THE WAY IN WHICH RESOURCES OF GIFTED SOCIAL PERSONNEL ARE BEING BIOLOGICALLY CONSERVED AND SOCIALLY UTILIZED

1. The mechanism of social selection including—
   (*a*) The educational recruitment of social classes.
   (*b*) Relation of maximal to initial earnings.
   (*c*) Changes of occupation at various ages of life.
   (*d*) Vertical, horizontal, and regional mobility within industrial and social units (including recruitment of administrative and political personnel).
2. Differential fertility and the social and economic factors which affect it.

PART III

INTER-RELATIONSHIP OF QUANTITATIVE AND QUALITATIVE ASPECTS OF THE POPULATION PROBLEM

1. Growth and delimitation of social classes.

2. Relation between total and employable population.
3. Effect of urban concentration (housing policy to be taken into account) and of occupation upon fertility and public hygiene.
4. Relation of population density to administrative and industrial efficiency.
5. Change in general standards of health, education, and social efficiency.

It is observed that there has been scarcely any attempt made to give precision to the phenomena of social class ; though the term is in the mouth of everyone, no one can do more than guess at the relative sizes of the various classes. No study has been made into the possibility that there may be an ' optimum ' size of city, and that the ' optimum ' for industrial, governmental, health, and social purposes may not be the same. Housing policy has not been considered from the point of view of the recruitment of the population, and it is possible, if not probable, that the houses built since the war do not allow for that proportion of four- and five-child families which is necessary if the population is not to decline.

The Co-ordinated Study of Human Heredity

It has been said that we now know more about the biological laws of descent, the genetics, of cattle and horses, than we do about human beings, although knowledge of the latter must be immensely more important. Research on man has been much less in extent than that on plants and animals, and

while it is true that basic studies in genetics must necessarily deal with the simpler organisms, the science is no longer in

such an elementary stage that the neglect of the overwhelming claims of studies on man can be explained, save by the absence of suitable opportunities for their prosecution.

Certain it is that from the genealogical end the study of heredity is in its infancy. Very few people, even after prolonged and expensive research, can give their *seize quartiers*, the surnames of their sixteen great-great-grandparents, and twelve or thirteen names is frequently the limit. Still less do they know any details about many of them, even their length of life, their callings, and other salient facts. Research effort is usually confined to tracing descent a long way back in the single male surname line, with perhaps occasional reference to important other available lines. Official registration is now a century old, and perhaps in the course of time some genealogical record in detail will be a quite common or even requisite personal possession, from which, by inductive processes, the laws of descent will be more clearly seen. Meanwhile, on certain physical or physiological traits, eye colour, height, susceptibility to insanity and particular diseases, a miscellaneous body of facts or evidence is being collected about dominants, recessives, etc., which is scattered all over the civilized world, unco-ordinated and unclassified. An International Congress in 1932 drew a scheme (from which the above quotation is drawn) for a central clearing-house of Human Genetics, with affiliated National Bureaux on lines analogous to the already existing Imperial Bureau of Animal Genetics. They considered that studies—on the lines of cited research into psychopathology, schizophrenia, manic depressive insanity, race-crossing, amaurotic idiocy, tubercular diathesis, identical twins, and hereditary eye diseases, with standardization of

measurements on the living—in many directions needed formulation and energetic pursuit. There is a conspicuous absence of machinery

by which specialist knowledge can be made available wherever it is needed ; only the most courageous thinkers are prepared to recognize a problem with which at the moment they are incapable of dealing.

Another international conference on Social Work brought declarations of discouragement

in that the work attempting amelioration of the distress produced by disease, delinquency, or poverty did not appear to decrease with the passage of years of careful effort, but rather showed steady growth—it was felt that the important aspect of heredity had been hitherto ignored.

Steps are now being taken to set up a British National Committee for Human Heredity, which can stand co-ordinated with existing organizations in ten or more other countries (*e.g.* the Dutch Institute for Human Genetics, Sweden's State Institute for Race Biology). This organization would also focus particular aspects of the work of numerous bodies in this country. Apparently the effort is to be precariously dependent upon piecemeal funds, whereas for the best results an assured income of considerable size is requisite.

Education

The university scholarships available in the social sciences are negligible compared with those given in classics and humanities. An immense drive to encourage a greater number of students in this field is long over-due, for if competent research workers, to use the projected increase of research funds, and com-

petent professors and lecturers are to be available, we must start with the 'raw material' from the public schools. But this imposes corresponding obligations on the educational courses. In the United States, at any rate, courses in social science have tended to be 'snaps'. Rightly given they should be as difficult, and call for as much thought and scholarship, as any of the natural sciences. They are in many senses more exacting in thought processes because they cannot employ all the same concrete methods available in the physical sciences. Professor Elwood, of Duke University, said recently that careful thinking, and not processes, is the true basis, and of course this is the rarest of disciplines. The University may train in techniques but fail to produce true scholars. He also deprecated the extremity of the present urge to make social studies 'more practical'.

> If the social sciences are enslaved to various forms of practical social work they certainly cannot be expected to produce true scholars, but only persons who are skilled in certain social techniques.[1]

I do not plead for making many of the social sciences school subjects, but for putting the scholarship system more definitely in the line of their advance by additional financial aid, or a redistribution of funds.

American psychologists have begun useful research into personality quotients (P.Q.) analogous to the well-known intelligence quotients (I.Q.). They are sometimes correlated inversely. Dr. H. C. Link declares that people's minds may improve while their personalities deteriorate. Presumably book-learning

[1] 'Scholarship in the Social Sciences', *Duke University Register*, January 1936.

often emphasises introversion. "The solution of this paradox—a growing intellect and a stationary or shrinking personality—is the most important problem confronting our educational system today".

Economic Analysis

Although the number of graduates emerging from the Economic Faculty of our Universities is ten times as great as it was a few years ago, the proportion who are free from business, teaching, and other activities, and available for sustained research and analysis, is pitifully small. The funds available for pure research in other sciences have nothing comparable in this field. Finance, in considerable measure, is wanted in two fields. We have no 'fact-finding' research institute comparable with the National Bureau in the United States, which can take up, with a team of whole-time workers under expert direction, subjects of national importance, free from governmental or political limitation or inhibitions, and can issue reports just as generally acceptable and free from 'bias' as are the reports issued by an agricultural or biological research institute. But in the second field we have few first-class minds free to deliberate on sustained economic analysis. The important issues raised by certain elements of truth contained in the confused 'Douglas Credit' diagnosis of deficient purchasing power, by J. A. Hobson's theories of under-consumption dependent upon maldistribution of income, by J. M. Keynes' equation between saving and investment, and his later provocative analysis of the 'propensity to consume', all need resolute and vigorous analysis by a considerable number of thinkers, instead of the hand-

ful of competent persons at present having the leisure and the equipment for the task. Whether a considerable element of under-employment, apart from frictional and cyclical unemployment, is, or is not, actually and preventably inherent in the present industrial and economic system is a first-class issue, much transcending in importance any current problem in physics or engineering. Research into economic problems in general is not endowed or 'financed' at all.

The tendency to introduce 'price controls' of various kinds is a phenomenon of far-reaching significance. Its effects need intensive realistic examination and research. For it is one thing to achieve a measure of success in the objects aimed at within a particular field—although even that sometimes is only done with difficulty and some surprises—but it is quite another to gauge or prevent the serious repercussions in the other fields adjacent thereto. 'Price controls' have been introduced in marketing schemes, in cartels, in rings, in trade-union wage agreements, in war-time contracts, in the regulations of totalitarian states—the modern economic community is full of rigidities introduced against the effects of free competition. Research is wanted on a wide scale into the technique and success or failure within the attempted field, but still more into their effects collaterally in other fields—an almost unexplored area. We do not know whether a measure of price control for new products to prevent the *wanton* and uneconomic destruction of human and capital values in the older products, for small marginal advantages, is a feasible or desirable device, because we have no adequate knowledge of the effects of what has already been done.

Age and other Discriminations in Unemployment Relief: Transfer Bonuses

The range of desirable research into the psychological reaction to unemployment relief in relation to the incentive for seeking work, to change of occupation, to readiness to train for such changes, to willingness to accept a change of neighbourhood, is very wide. When these reactions are graded in age-groups, we may well find important differences. An enquiry being conducted at the present time from St. Andrews University by Dr. Oeser into juvenile unemployment is one aspect of it. The Institute of Statistics at Oxford University (total income, 1936, £1420!), with Barnett House, is analysing some 30,000 unemployment books of workers coming from other districts, to determine the existing limitations of the mobility of labour, and other problems. At present we have a few scattered facts and many opinions and surmises. It may be possible to discover whether any differentials in the payments of relief would be to the social advantage in overcoming reluctance to change, such as a higher individual rate in a different area, where employment is more likely to be available than in the area to which the individual is clinging, or a higher rate for a change of occupation, both as applied to ages or conditions where transition is desirable. Only wide-scale research can tell us the extent of the trouble to be corrected and the true frictional elements involved.

Allied to the foregoing might be the application of direct-subsidy methods as inducements to change location or occupation. When sufficient data has been accumulated, some of the problems could be the subject of judicious local experiment.

The statistics already provided by the Ministry of Labour indicate clearly that the industries which have been giving less employment are not those in which technological advance is most rapid. In coal mining, as much decrease is due to loss of export markets and the economy in the use of fuel as to coal-cutting and similar machinery. The growing industries have increased employment more than the declining industries have decreased it, and the former are not those in which there is no mechanical advance. The motor industry has increased by 43 per cent in employment from 1923 to 1934, but technological change has been taking place all the time. The Austin Works employed 55 men per car in 1922 and only 8 men per car in 1934, but the total number went from 3000 to 16,000. If the number of people employable grew in this period by over a million, and unemployment, with two millions instead of a million, remains stationary, industry has been equal to the task of employing an extra million, but not to the double task of absorbing the additional and new employables and the extra unemployed. Which is the million so absorbed? Is it the new employable or the old unemployed, and if part of each, in what proportions ? Sir William Beveridge has skilfully drawn many deductions from the available figures, but there is room for intensive sample enquiry into personal records of unemployment, change of occupation, and change of place. How far does unemployment relief act as a buffer against change in both ? How far does Trade Unionism reduce mobility ? How far is declining industry loaded with unemployed and how far expanding industry hindered by not getting the class of labour it requires ? How far do the stabilizing influences of pension and

analogous rights act as anchors against change of occupation or employment, and the instalment home-purchase system act against change of place ? If it is found that these are important restricting elements, a governmental or industrial clearing-house of such rights and obligations, and a voluntary exchange, might enable the individual to transfer without loss, and the same would apply to any other vested interests he may have accumulated under the postulate of a life career in one place or one industry.

The facilities for technical education are widespread and of a high standard, but we do not know their final social consequences. If the history of each student could be followed up in later years, it might be possible to determine how far unco-ordination and misdirection at an early stage had created a surplus for a particular calling ; how far its very specialism had unfitted for alternative vocations ; how far a modification of the training could give a wider range of adaptability to life's vicissitudes, and whether technical training fits or unfits for a changing world. We do not know what proportion of employees in particular lines have been technically trained, or what proportion of the students retain that particular direction afterwards. The field of technical education in relation to subsequent industrial and social activity is empirically covered, and the scientifically ascertained facts are few and far between.

* * * *

In none of the foregoing have I made proposals for action, but only theories of proposals which are the working hypotheses as a basis for research and fact-finding. Such provisional questions based on theories can be changed as the work proceeds, but they all seem

to be as vital elements in real knowledge as the interaction of chemical elements, and the new directions and kinds of physical force. In a new sense "the proper study of mankind is man". Sir Richard Gregory says:

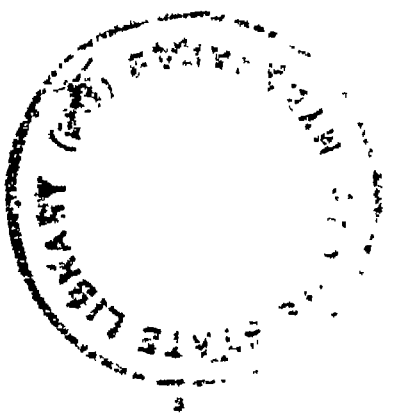
> The impacts of science with society are now so numerous that scientific studies in the realm of social biology are even more necessary for civilized life than researches in the physical sciences.[1]

And Professor Hogben says:

> We shall not harmonize the public needs of a progressive society with the private needs of human nature until we have a science of human nature.[2]

Some will say, without hesitation, that these difficulties are inherent in an individualistic society and cannot be solved save by a socialized or planned State, either communized or dictated, but totalitarian. Others will reply that even if these weaknesses of the present system are made good in a substituted one, we shall merely change over to new evils, for the strong points of the present system will be the weak points in the new. So much ought to be admitted by those who hold this view, or would test it out still longer: that it is for them to toil scientifically to justify the continuance of the principles of individualistic society by such regulation and knowledge as will purge it of its patent defects—its 'plenty' produced and unused in the midst of poverty, its potentiality unexplored—and such as will conserve those human qualities that have made our present civilization.

[1] R. A. Gregory, *Proc. of Royal Inst.*, May 1936.
[2] Prof. Hogben, *Retreat from Reason*, p. 22.



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